AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

AUGUST 1928

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Weed Control in the Spring Wheat Area[1]

By Robert H. Black[2]

THE enormous weed crop raised with the grain every year is one of the chief reasons why larger yields of grain per acre are not obtained in the spring wheat area.

Wheat, rye and flax are the three principal cash grain crops of this area. When the grain is hauled to and sold at the local market the percentage of weed seeds and other foreign material found in it is ascertained by the grain buyer, and a weight that is equivalent to the weight of the foreign material in the grain is deducted from the weight of each load of grain before payment is made to the farmer. The weed seeds and other foreign material found in the grain, when it is sold on the market, is referred to as "dockage." The process of determining the amount of dockage that is in any given lot of grain and of deducting its weight from the grain containing it is usually referred to as "assessing dockage."

Losses caused by weeds occur in both the production and marketing of grain. Weeds in grain fields cause a reduction in the yield of grain. There are several reasons for this. Weeds in grain fields occupy space which could be occupied by grain plants, if the weeds were not there. Tall weeds like kinghead and lamb's quarters not only crowd out the surrounding grain, but also shade it, which prevents the proper filling out of the grain kernels and retards the ripening of the grain.

During certain periods in nearly every year, parts of the spring-wheat area suffer from lack of moisture, and during such times the weeds in the grain fields use much of the soil moisture which is seriously needed by the grain plants. Weeds also rob the cultivated crops of much of the available plant food in the soil, which tends to reduce yields. This is especially harmful when the soil is deficient in one or more of the essential plantfood elements.

Other weeds like lamb's quarters, pigeon grass, and Russian thistle, which contain large quantities of moisture at harvest, hinder the operation of combines, the drying of the grain in the shocks, and often causes the grain to heat in storage after it is threshed.

[1]Paper presented before a meeting of the North Central Section of the American Society of Agricultural Engineers, at Ames, Iowa, May, 1928.

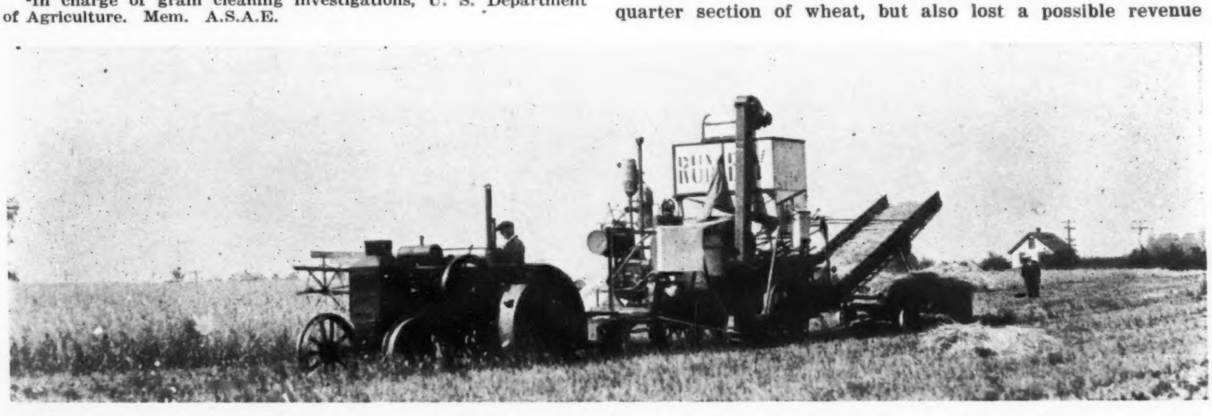
[2]In charge of grain cleaning investigations, U. S. Department of Agriculture. Mem. A.S.A.E.

The average dockage found in the wheat that is delivered to the local elevators in the spring wheat states, varies somewhat from year to year, but it is noticeable that those districts, which have a high dockage in any one year, usually maintain a relatively high dockage for several succeeding years.

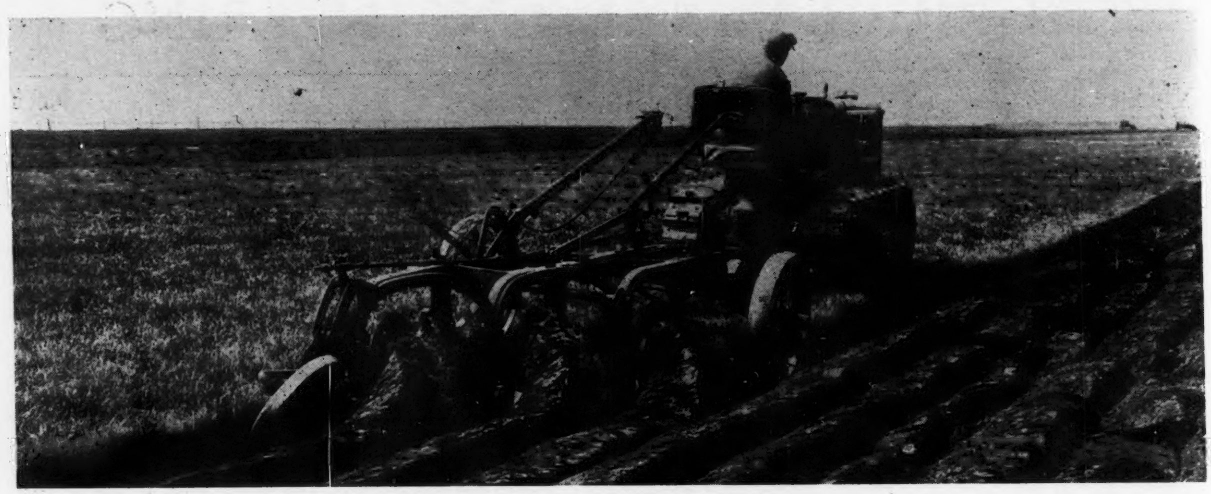
The U. S. Department of Agriculture has estimated that the spring grain crop is reduced each year from 12 to 15 per cent on account of weeds. This is discussed in full in Yearbook Separate No. 732, which also points out that, in addition to a loss in both the quantity and quality of grain produced, there is an increase in the cost of production and marketing caused by the weeds in the grain. Weeds also provide harbors for insects and disease which in turn further contribute their share to the reduction of both the quality and quantity of the grain.

North Dakota produces more spring wheat than any other state. For the 1926 crop in that state the average spring wheat yield was 8 bu. per acre. The dockage (average) in the 1926 crop of spring wheat as threshed in the state was 9.1 per cent. From these figures it appears that on an average each acre of wheat, in addition to producing 8 bu. of wheat, also produced 48.1 lb. of dockage, and that on this basis the average production of weed seed dockage for each quarter section was 7,696 lb. Had the soil and seed wheat been free of weed seeds, and had the weed-seed dockage been replaced by an equal quantity of wheat, the farm value per quarter section of this additional wheat at $1.17 per bu. would have been $150.07.

In addition to the fact that the producer loses this $150.07 per quarter section, there was also an expenditure of cash and labor to produce the dockage. At a cost of $6.86 per acre for twine, cutting, threshing, marketing, and overhead, the cost of producing and marketing the wheat and dockage from a quarter section was $1,097.60. This cost does not include the expense of plowing or other incidentals, but includes only those expenses which are incurred after the crop is grown. The proportion of this expense which should be charged to the dockage, 9.1 per cent, is $99.88. This indicates that the average North Dakota farmer not only spent nearly $100 in harvesting and marketing the dockage from each quarter section of wheat, but also lost a possible revenue



The enormous weed crop that is raised wtih the grain each year in the spring wheat area is placing a serious handicap on the most efficient use of the combine—a handicap that sooner or later must be overcome



Plowing virgin sod with a track type tractor in North Dakota. Here the accumulation of weed seed is at a minimum. Clean seed grain and proper farming methods will maintain this condition

of $150 in the value of the wheat that might have been raised in place of the weeds.

The average annual production of dockage in North Dakota has been nearly as much as the production of corn and about two-thirds as much as barley, whereas the farm value of the dockage was less than one-half the value of the barley crop.

Some additional losses to the grain producers as outlined before include the weed seeds that shatter and fall on the ground before and after cutting which tend to reduce the yield of future crops; the lower price which is received for the grain because it contains the weed seeds when sold on the market; and the removal of the comparatively large amounts of moisture and fertility from the soil in the production of the dockage which had a tendency to reduce the yield of the wheat.

Other states in the spring-wheat area suffer a similar loss, the amount depending on the percentage of weeds found in the grain.

Weeds are found in grain fields, either because weed seeds have been sown with the seed grain or because the soil contained weed seeds which had shattered from previous crops. Practically all of the weeds now found in grain were originally introduced into the wheat fields in seed grain. Most of the new kinds of weeds, introduced into the spring-wheat area within the last few years, have come through either grass seed or through seed grain brought from other areas.

Some weeds like the sow thistle are also blown by the wind from neighboring fields; other weed seeds are carried to clean grounds to some extent by flood water, birds, and threshing machines; and are carried in feeding stuffs which contain weed seeds and which have not been properly ground before feeding.

After the weed seeds have been sown with the grain or have reached the grain fields by some other means, their increase is natural. Many weeds, like wild oats, mature part of their crop before the grain is removed from the field, and the seeds from such weeds are scattered on the ground before and during the harvest. Many of such seeds are plowed under before they have had an opportunity to sprout and some do not sprout for several years. The number of weed-seeds found in soil which has been continuously raising grain crops is almost unbelievable.

Most kinds of weed seeds will remain in the soil in a viable state for several years and will germinate and grow into plants wherever they are brought near the surface through plowing or other cultivation.

At the North Dakota Agricultural Experiment Station, a square foot of soil, 5 in. deep, taken from a field that had been cropped to wheat each year for 15 years was found by the station officials to contain 1,908 pigeon grass, 1,205 French weed, 540 lamb's quarters, 216 wild buckwheat, 92 wild rose, 88 wild oats, and 162 miscellaneous weed seeds—a total of 4,211 weed seeds per square foot or 183,000,000 weed seeds per acre. Wheat is sown at a rate of slightly less than 1,000,000 wheat kernels per acre.

The usual method of destroying weeds in the soil is by crop rotation, using either cultivated or forage crops. Rotations which contain only grain crops, like wheat, barley, oats, rye and flax, will not destroy the weeds in the soil but ordinarily will increase their number. Cultivated crops like corn, potatoes, and beets encourage the sprouting of the weed seeds and proper cultivation of these crops destroys the weeds after the seeds have sprouted. Forage crops like alfalfa and sweet clover prevent normal growth of the weeds and thus prevent their seed production. By smothering such weeds these crops assist in cleaning the soil.

There is a general supposition that most of the weed seeds that are in the soil will rot within a few years, but this is not true of many of the worst weed seeds found in the spring-wheat area. In an experiment begun in 1902, by J. W. T. Duvel, of the U. S. Department of Agriculture, 107 species of seeds were buried in pots of soil at various plowing depths in a field of the Arlington Experiment Farm at Rosslyn, Va. In 1912, 10 years after being buried in the soil, 69 species grew; and in 1923, after being buried for over 20 years, 51 species grew. It is evident that the seeds of most weeds when plowed under will not perish during the period of any normal crop rotation.

Some of the weed seeds lying on or near the surface of the ground can be destroyed by disking immediately after the grain is cut. Such disking causes most of the seeds to sprout before frost and then the frost kills the weeds before a new crop of seeds can be produced.

Other weed seeds, like pigeon grass, usually mature on a stem that is shorter than wheat so that many of them are not removed with the grain. Often the pigeon-grass plant does not mature seed until after the grain crop has been cut. Thorough disking immediately after the cutting of the grain crop will also kill those plants which have not yet matured seeds.

In some localities it is a common practice to run sheep on the grain fields immediately after the grain is removed so that the sheep eat and destroy the pigeon grass and other weeds, which will grow and mature seeds at that time of the year if allowed to remain undisturbed in the stubble.

While the principal losses from weeds occur in the grain fields of the north central section, weeds are also a serious menace in pastures and meadows.

Much of the efforts put forth by farmers in attempting to control weeds has been foolishly employed. Large amounts of money have been spent in the purchase of machinery which was not fitted to the conditions of the area in which

it was supposed to be operated, to effectively control weeds.

Much information available to farmers on methods of controlling weeds is considerably lacking, and it is true that agricultural colleges, farmers and manufacturers have issued many publications on the subject, but many of these publications have been written without full understanding of how to properly control weeds.

Those state agricultural experiment stations that are now conducting projects on weed control, found that there is a vast amount of work to be done before weeds can actually be controlled within this section.

It has been my intention in this paper to point out that weed control is not generally intelligently practiced throughout the north central section; that basic information on this economic question is lacking; that those agricultural experiment stations that have established weed control projects are not assigning adequate funds and personnel to the project, and that because this is one of the most important economic problems now confronting the farmers of the north central section, I suggest that the North Central Section of the American Society of Agricultural Engineers assign a committee to encourage further work on this subject.

Tractor Plowing in Stony Ground[1]

By H. B. Josephson[2]

MANY of the best producing farms in Pennsylvania are infected with tight limestone rocks near the surface. The most common plowing outfit used on such land is the walking plow drawn by two horses. Horse gang plows are not used because of rocks. In tractor plowing these rocks are a real menace and some tractor owners, although recognizing the merits of the tractor for seedbed preparation, cutting grain and loading hay, prefer to do their plowing with walking plows. This is a serious situation in view of the great number of tractors used by farmers in the state. The "Farm Implement News" estimated on January 1, 1928, that there were 33,873 tractors on Pennsylvania farms.

Effect of Rocks on Work Accomplished. Careful records were kept with two different two-plow tractor outfits on the Pennsylvania State College farm in 1926. Two fields were plowed with each outfit as follows:

1. Field containing only a few stones.
2. Stony field (typical of large sections in Pennsylvania).

The amount of plowing accomplished with Tractor A on the stony field was 42 per cent less than that accomplished on the field containing only a few stones. With Tractor B 36 per cent less plowing was done.

Spring release hitches were used on both plows. These are essential to avoid strains and breakages, but in stony ground the operator must continually slow down to avoid tripping the spring release unduly often.

The main time loss occurred in rehitching, but a great deal of time was lost in slowing down in places where the plow was expected to strike a rock.

Fig. 1 shows the spring release hitch used on one of the plows in these tests. Each time the plow hits a solid rock the spring release is tripped. Fig. 2 shows another hitch that was later adapted to this outfit to make it possible for the operator to rehitch without leaving the tractor seat. This was an improvement that resulted in considerable saving in time and energy.

Increase in Cost of Plowing Due to Rocks. Records were kept on a two-plow tractor outfit during the seasons of 1926 and 1927 under different conditions. The cost of plowing ranged from $2.33 per acre on fields containing only a few rocks to $3.47 per acre on moderately stony fields and $4.07 per acre on very stony fields. The increased cost due to rocks was then 49 per cent for moderately stony fields and 75 per cent for very stony fields. Fig. 3 shows graphically the distribution between the power, labor, and machinery costs under the various conditions mentioned above. The cost of plowing with teams on moderately stony fields was found to be $3.91 per acre and varied but little under different conditions.

Possible Remedies. In seeking a remedy for the difficulty encountered in the use of tractors in plowing stony

	Acres plowed per 10-hour day	
Description of field	Tractor A	Tractor B
Few stones	6.4 acres	6.06 acres
Stony ground	3.7 acres	3.90 acres
Difference	2.7 acres	2.16 acres
Per cent difference	42	36

[1]Second of a series of six articles based on the results of a power and labor research study at the Pennsylvania State College. Released for first publication in AGRICULTURAL ENGINEERING as Technical Paper No. 453 of the Pennsylvania State College, School of Agriculture and Experiment Station.

[2]Agricultural engineer in charge of farm machinery research, Pennsylvania State College Agricultural Experiment Station. Mem. A.S.A.E.

Fig. 1. (Left) A great deal of time is lost in plowing stony ground when the operator must get off the tractor each time the spring release trips. Fig. 2. (Right) This simple device saves time and energy when the spring release is tripped often due to rocks

ground, the following are some ideas which would seem to merit consideration:

1. Removal of rocks
2. Disking or cultivating instead of plowing for certain crops
3. Improvement in spring release hitches so that less time will be lost
4. Development of special plows or accessories for the standard plows to meet these conditions.

The removal of rocks naturally presents itself first for consideration. Some studies have been made to determine the cost of clearing this land. The cost of clearing land described here as moderately stony was found to be from $35 to $53 per acre. This will be gone into more fully in a succeeding article in this series.

Plowing less often and substituting with other operations which are less affected by rocks, such as disking and cultivating, would no doubt result in greater economy in producing certain crops. In view of the corn borer situation and the importance laid on clean plowing in the interest of corn borer control, it would seem that no substitution can be made for plowing for some time to come.

The spring release hitch is the only thing so far devised to meet the conditions of plowing in stony ground. In saving the plow from strains and breakages, the spring release hitches now on the market serve their purpose. The fact remains though that a stop occurs each time the plow catches on a solid rock. In some cases after the spring release acts the operator must get off the tractor to rehitch. A good hitch reduces the time loss considerably. It does not seem, however, that the ultimate solution of this problem will be found in the hitch; rather it should be sought in the plow itself.

Two Types of Rocks to Consider. The problem of designing special equipment is complicated by the fact that in most cases there are small loose rocks in addition to the tight rocks. The loose rocks offer no special difficulty in plowing when large ones are not present. Those of any considerable size (above 6 in.) are usually removed. It is not uncommon, however, to find a mass of small flat rocks in combination with the solid rocks. These complicate the problem of designing special equipment in that they make it difficult to use rolling coulters or any similar device.

Requirements of Plow for Stony Ground.

1. It should roll freely over solid obstructions
2. It should not be thrown out by small loose rocks
3. It should have all the suction of the conventional type of plow
4. Parts encountering rocks must not be submitted to excessive strains
5. Power requirements must not be greatly in excess of those of the regular plow.

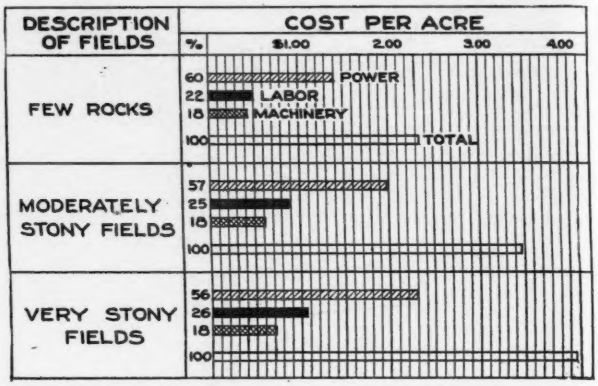


Fig. 3. Cost of plowing with a two-plow general-purpose tractor under different conditions in Pennsylvania

It might here be stated that an increase in cost from that of the regular plow would be expected and, from the following figures, seems justifiable if the amount of work accomplished can be substantially increased.

In plowing moderately stony ground it has been found that the cost is distributed as follows: Tractor, 57 per cent; labor, 25 per cent; and the plow, 18 per cent. (See Fig. 3.)

Just by way of conjecture let it be assumed that a plow costing 50 per cent more should increase the capacity of the plowing unit to nearly what it would be on a field free from stones. The available figures indicate that there would be a substantial decrease in the cost of plowing.

The use of tractors on Pennsylvania farms, as well as elsewhere, is rapidly increasing. Plowing, when stones do not interfere, is the best tractor operation on the farm, and can be done more cheaply than by common Pennsylvania practice[3]. Under existing conditions, however, tractor plowing is often very difficult and in some cases not profitable due to rocks. This is a real agricultural engineering problem and its solution or even its partial solution would be a great contribution to Pennsylvania agriculture.

[3]AGRICULTURAL ENGINEERING. Vol. 9, No. 7, p. 219.

THE HYDRAULIC RAM

The possibilities of the hydraulic ram are probably not appreciated anywhere near to the extent they should be. In sections of the country having a rolling topography, many springs are found near farmsteads, but at a level considerably below that of the buildings. In such situations, as well as in others to which it is adapted, the hydraulic ram offers an excellent means of supplying water to farm buildings at small cost. Agricultural engineers in making their contribution to the increased efficiency and well-being of agriculture, may well give this useful piece of equipment greater consideration than it has had in the past.

Some Aspects of the St. Francis Flood Damage of Interest to Agricultural Engineers

By J. P. Fairbank[1] and J. B. Brown[2]

THIRTY-EIGHT thousand acre-feet of water rushed through the Santa Clara Valley the morning of March 13, between midnight and daybreak, as a result of the failure of the St. Francis Dam.

After the refugees had been cared for, the leaders in the community began to take stock of the damage. The flood traversed one of the most productive areas in California. The flood line crossed Ventura and part of Los Angeles county, flooding approximately 24,000 acres of farm and river bottom lands. The agriculture in the flood zone comprised citrus, walnuts, deciduous fruits, alfalfa, beans, pasture and some grain and truck crops.

It was evident that the greatest material loss was to agriculture, but to determine the damage was a perplexing and sizeable task. Committees representing the city of Los Angeles and Ventura County wanted a disinterested organization to survey the damage to agriculture—not to appraise the loss in terms of money, but to collect and report all available pertinent facts which would serve as a basis for final settlement by the City of Los Angeles.

The committees agreed upon the agricultural extension service of the University of California, and the governor immediately authorized the University to undertake the work. A staff of twenty-three was detailed to the work. Seventeen were farm advisors who were familiar with the types of agriculture typical of the flooded area. The remainder of the force was composed of subject-matter specialists from the Berkeley office. Warren Schoonover, specialist in citriculture, was in charge of the survey. The other specialists were in farm management, walnuts, irrigation and agricultural engineering.

There were six field parties, usually three men to a party. These three men were selected with regard to their experience and specialty to give a well-balanced group capable of making a correct estimate of the damage to crops and soil. The specialists in farm management, irrigation and agricultural engineering spent part of their time in the office on reports and coordination and part in the field helping the field parties with special jobs.

The field reports were worked up into final form by the office force; each report was approved and signed by every member of the party which took the record in the field.

Much credit is due to the field parties. They worked long days out on the ranches, walking miles and making many soil borings, counting every tree in each tract or block, searching for owners or tenants and then searching them for facts; and at night wrote, read and corrected reports. It was a hard working, loyal group.

Three hundred and eighty reports were made; of these three hundred and twenty were for owners of land and sixty for tenants. The original estimate of the number of total reports was less than two hundred. The original guess was two weeks time, but it took six weeks and we were fortunate to finish it in that time, considering the mass of detail.

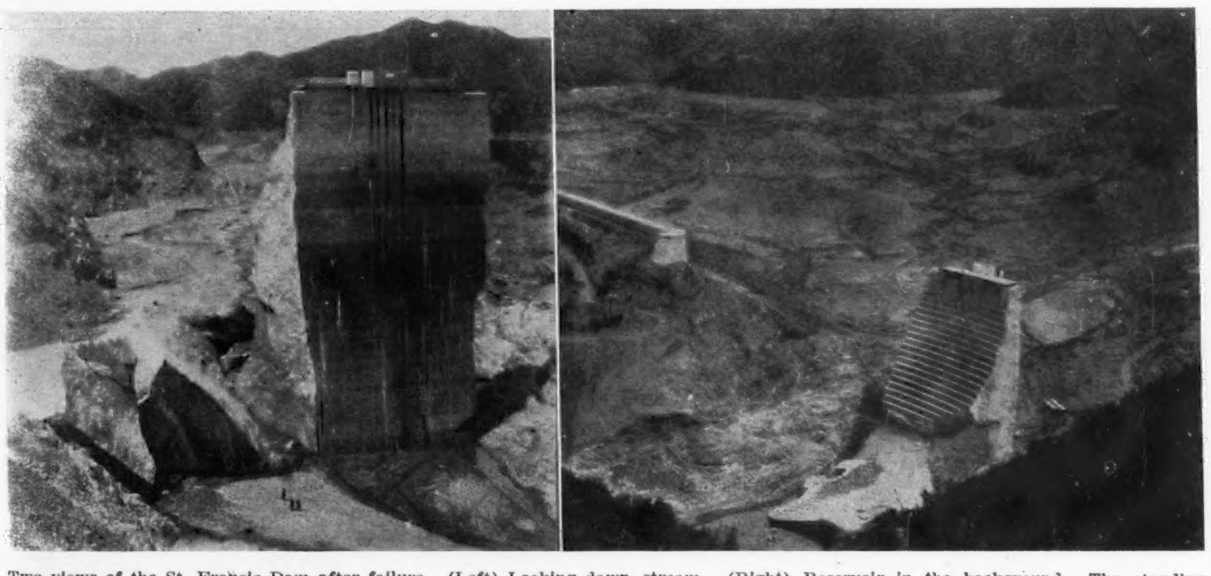
Records and Field Methods. The work of field parties was divided into the following classes: (1) Damage to land; (2) damage to trees; (3) damage to irrigation systems and structures; (4) damage to farm buildings (other than houses); (5) damage to farm equipment, and (6) losses of livestock.

The owner or his representative was present at the time the committee examined his property and accompanied the committee all of the time they were on his place. Records were taken in such detail that there have been very few complaints as to the correctness of the reports sent out.

A surprising feature of this work has been the gradual realization on the part of farmers that their places have not been completely ruined. Things, of course, looked pretty bad when the land was covered with debris, trees broken down and buildings and stock washed away, but when the debris was cleaned up, many began to realize that they had not been damaged nearly as badly as they had at first thought. One advantage in having an organization like the

[1]Agricultural engineering specialist, agricultural extension division, University of California. Mem. A.S.A.E.

[2]Irrigation specialist, agricultural extension division, University of California.



Two views of the St. Francis Dam after failure. (Left) Looking down stream. (Right) Reservoir in the background. The standing section is about 100 ft. wide and 200 ft. high

University agricultural extension service take over the survey of flood damage lay in the fact that the committee men had a far better idea of the quality of land and trees on most places than did the owner himself. From the remaining trees and from packing house records they were able to judge the producing capacity before the flood. The care taken in estimating damages has saved the City of Los Angeles many hundreds of thousands of dollars in actual damages as well as aided in avoiding litigation.

Damage to Buildings. The total building loss is as yet a question. A rough estimate was placed by some at 450 buildings of appreciable size. Our survey did not include residences, except to note them and report a loss of a dwelling to the housing committee.

Like farm machinery, the facts in regard to farm building loss were elusive; in some cases not even a foundation was left to show the floor area. The nature of the damage was practically everything that could happen to a building except fire. In some cases merely the floor was covered with silt; some were shifted on their foundations; others were placed on other property; some owners found several houses on their property where before they had but one. Occasionally a house stayed on its foundation, but usually it had a wall caved in by debris.

In the outskirts of Santa Paula there are two adobe brick houses with no damage other than flooding, while on all sides frame buildings were demolished or floated away. However, it is no doubt fortunate for the adobe that the flood was of short duration.

Damage to Farm Machinery. Appraisal of farm machinery losses could not be exact. Much of the machinery which had been left in the fields had been swept away and was never found and identified. For example, one new tractor and scraper which had been used but two or three weeks on a leveling contract, were reported lost. Only the steering wheel of the tractor was found nearby. About a month after the flood the owner reported to us that he had found the scraper in a sand pit about a quarter of a mile from the spot he had left it. It was discovered after the water in the pit had seeped away, and then only a few inches of the lever was projecting above the sand. The tractor has not yet been found, so far as we know. In cases where the machinery had been swept away, the survey committee could only report the owners' statement of loss, and this was often meager, as frequently he had little or no idea as to the size, make or age of the equipment. Around and in buildings the machinery was covered more or less completely with silt and debris, and often the only damage was the labor required to completely disassemble the machine and clean it out. This was quite a job in the case of tractors and trucks. One owner had a garage clean up two of his Ford trucks; the bill amounted to over $100 each.

One owner reported damages to the extent of renewal of his tractor engine. It seems that, as the tractor was merely submerged, he figured that all he needed to do was to drain the crankcase and start to use it, which he did, but the sand in the bearings soon ruined the engine.

Sulky rakes usually had at least one wheel bent out of shape. Even where implements were moved but little, the impact of debris caused considerable damage. At first glance, an implement might look like a total loss, but frequently upon checking it over point by point with the owner, he readily agreed that the main job was cleaning it up, making some minor repairs and possibly repainting it. Naturally a quantity of machinery was so twisted out of shape that it was a total loss.

When the flood passed through a repair shop, the job of checking was most tedious; an inventory under ordinary conditions will now seem a simple task to some of our crews.

Damages to Irrigation Systems. There were a number of small ditches taking water from Santa Clara River. In practically every case the head works consisted of a brush and rock dam with simple wooden head gates. All of these works were destroyed and have been replaced by the City of Los Angeles. Construction work has usually been of good quality.

Pipe lines in the flooded area suffered in three ways: (1) They were completely broken up and washed away, (2) they were filled with silt, and (3) the land which they served was washed away leaving the pipe exposed or was filled several feet with sand, hence being no longer valuable as agricultural land.

Silted pipe lines are being cleaned and other lines replaced. Open ditches were usually filled with sand.

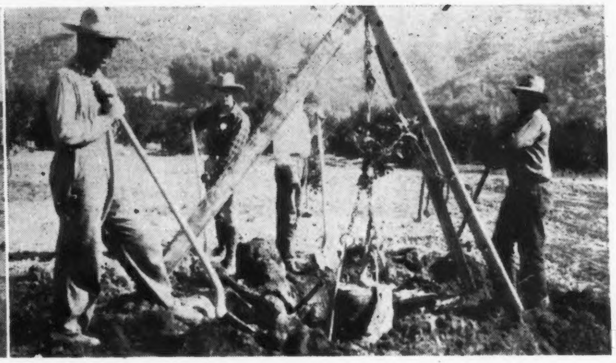
On one ranch near Piru, the head works and upper 700 ft. of a 30-in. gravity line were destroyed and the bed of the stream eroded to a depth of 5 ft. below the bottom of the former headworks. On replacing this system, the City of Los Angeles extended the line 1,000 ft. upstream above the old headworks, constructed a thoroughly adequate concrete heading and used in all 2,900 ft. of 30-in. concrete pipe in repairing the line. About 700 ft. of Hume Process pipe were used in this work; this was used because it was quickly available. It was necessary to reestablish the irrigation supply quickly.

A nearby ranch was supplied by a ditch about one-half mile long leading down to a pumping plant at the upstream boundary of the property where the water was lifted to higher tracts. After the flood the stream bed was so lowered that it was no longer possible to run water by gravity into the pump for the pumps. Pumps were installed in the river to lift the water 26 ft. into the old pump. This lowering of the channel will mean an annual expense to the owner, for operation and maintenance of these new pumps, of about $1,050. Probably the best means of adjusting this damage is by the payment of a capital amount sufficient to produce an annual income of $1,050.

The Reconstruction. The restoration of the agricultural area is of much interest to agricultural engineers. The City of Los Angeles promptly accepted the responsibility for the flood and mobilized men and equipment with remarkable rapidity. Arrangements were made with the association of general contractors to establish ten units in Ventura County on a cost-plus basis. Each unit was built around one drag line, usually equipped with a clam shell and about ten tractors in various sizes, together with a fleet of trucks as needed.

The work is under the able direction of J. E. Phillips, field engineer of the department of power and light of the City of Los Angeles.

(Left) Clam shell used to pile debris. (Right) Removing debris with a tractor



(Left) Digging a heavy fill of silt away from young trees, which were otherwise undamaged. (Right) The roots of the trees are wrapped in burlap, then lifted and reset

Debris. One of the first big jobs was debris, which was scattered and piled about in unbelievable quantities. The first task for the tractors was to aid in the search for bodies by tearing apart large drifts by means of cables and hooks. The handling of the debris was no ordinary problem and various methods were worked out in the field. Where the debris was very heavy, clam shells were used to pick it directly from the drift and pile it for burning. In other areas the debris was pulled up to the clam shells by tractors and cables. Large "stone boats" of steel construction pulled by tractors were used to haul the small debris to the piles. Several stone boats were handled by one tractor, so that several crews of laborers could keep a tractor reasonably busy.

As the piles of debris were too wet to burn readily at first, they were sprayed with oil by a large sprayer mounted on a truck and furnished by the state department of agriculture. This is probably the largest power sprayer in the state and is used by the department for spraying park trees in its white fly control work.

Heavy cover crop disks were used in cutting up light branches and twigs that were too small to be picked up by debris crews.

Dirt Moving. While the debris presented mechanical problems, it was simple in that there was but one thing to do—get it off the land and burned. The soil reclamation is complex, as it involves not only the vagaries of the flood, but the diversity and changing opinions and wishes of the landowners. Where large tracts of land were heavily eroded, there is probably little that can be done in the way of reclamation, at least in the immediate future. But where there are heavy deposits of sand or silt in valuable groves and about farmsteads, the City of Los Angeles is removing it where and as much as the owner requests. This is used to fill eroded areas near by. On one 68-acre tract, the City's engineers estimated that it would be necessary to move 60,000 cu. yd. of silt. On another 20-acre ranch, the estimate was 30,000 cu. yd. Some of the growers are not asking that all of the silt be removed if the land is levelled. Their decisions are of course based on the kind of crop, original soil and the nature of the deposit, whether it be sand or silt or sandy loam. Undoubtedly a few properties have been improved by the deposit.

Heavy silt deposits of course occurred where the stream flow was slow, and often the citrus trees were not badly damaged. In such cases, crews of laborers removed the debris and dug the silt from around the tree trunks. Then the silt was thrown into windrows by scrapers and occasionally by backfillers, when working close to the trees. Mechanical loaders travelled down the windrows, elevating the dirt into one-yard dump trucks ("whoopies"). The length of haul varied, naturally. We checked on one outfit which hauled about 240 loads a day 0.3 mile, with a loader and five one-ton trucks.

The field engineer has found the loaders not entirely satisfactory because of the amount of hand labor required to feed them, one type being particularly costly in that respect. He now plans to drag the dirt out of the orchard by means of scrapers or land levelers to clam shells, which will load the trucks. This should permit the trucks to haul larger loads ordinarily, as they can then run in a beaten road and not have to pull through the soft dirt in the orchards.

Aside from these heavy dirt-moving jobs, the City is doing much of the ordinary operations of leveling, and scarifying and disking up the roads made through the groves by their equipment—in short, putting the land back into first-class condition wherever possible.

One of the unusual jobs was to lift a young orange grove. The water laid a heavy deposit of loam over the tract, to which the owner did not object, but which would probably kill the trees. Holes were dug around the trees, the roots balled in burlap and then the entire assembly lifted bodily by means of a tripod and blocks and hooks. While suspended the dirt was filled in around the roots and irrigated.

Rates Paid.

Common labor, white, $4, and Mexican, $3.50 per day.

Tractors, from $15 for Fordsons to $42 for sixties.

Trucks, from $15 for 1-ton to $24.75 for 5-ton.

Loaders, $40.

Subsoilers, $10.

Disks, $2.

Revolving scrapers, $3.

The above prices are based on nine hours and in case of the motor equipment includes the operator. The city furnishes the oil and fuel.

Wells. Many irrigation pumping plants and domestic water wells were in the flooded area. There are instances of the wells completely disappearing, the plant being swept away and the hole filled.

Soon after the flood health authorities posted signs on wells which might be affected, warning against drinking the water. Samples of the water were taken for contamination tests. Those in charge of reclamation realized that water was of first importance, and early in the reconstruction work well crews of the city started reclaiming the wells, sand pumping where necessary, and replacing or repairing the pumping equipment. Many electric motors were submerged. Oftentimes these were sent to the shop to be baked.

Silted wells showed some loss in capacity for a short time after the flood. The reclamation operations were similar to the development work on a new well, that is, surging was necessary to bring wells back to their former capacity.

Slopes of the Santa Clara River. The following information on slopes of Santa Clara River may be of interest:

Average below Santa Paula, 15-30 ft. per mile

Santa Paula to Ventura County line, 25-35 ft. per mile

Above Ventura County line, 30-50 ft. per mile.

The Sacramento River in extreme flood for a distance of 150 miles above its mouth flows on a grade of less than 5 in. per mile.

The Control of Termites in Buildings[1]

By Thos. E. Snyder[2]

WHEN you find small, blackish, white-winged "ants" flying in large numbers in your house in the spring and fall, don't sweep them up, thinking they are merely outdoor ants, and then forget about them. They may be termites, or "white ants," and perhaps are destroying the woodwork of your home. I will undertake to tell you in this paper how to find out if they are there, before they have done much harm. I will also tell you how to build your house so they can't get in, and how to get them out and keep them out if they are already in.

People sometimes think that termites live only in tropical countries. This is a mistake. They are in the United States and are destructive wherever you find them. In the southeastern, central western, southwestern, and Pacific Coast states, however, their damage to the woodwork of buildings is especially bad.

Termites are not true ants, although they look much like them and live in large colonies made up of different forms. The winged male and female termites which you see "swarming" for a short time in the spring or fall are on their way to start new colonies. These parent termites are not injurious, but their descendants, the wingless workers of the new colony, are very destructive. These you rarely see, because they do not crawl about in the open but stay in the earth underground or in wood. If they want to reach woodwork above ground, they build earthlike tubes to crawl through. So they are always under cover.

Termite damage is always hidden inside the wood. The interior rafters, joists, beams, or other timbers of a building may be entirely eaten out before the insect vandals are noticed, since they leave a protective outer shell. Such damage is then hard to repair.

The termites which do the greatest damage to buildings and their contents, especially by weakening the supporting timbers, are those which live in the ground and attack wood indirectly from the ground. These ground-nesting termites can't live without moisture and this they get from the earth. If shut off from moisture in the earth they dry up and die.

The principal means (Fig. 1) by which termites get into buildings are as follows:

1. Untreated wood in basements, cellar or the foundations of buildings in contact with the ground; such places are where termite damage is most likely to start.
2. Termites are able to penetrate masonry walls where improper grades of mortar have been used in foundations, working up through the interior of the walls.
3. By means of earth-like shelter tubes, termites are also able to crawl up through them over impenetrable walls and thus infest buildings.

Irrespective of whether the proposed building, as to its main construction, is to be of masonry or wood, it is highly desirable, where practicable, to eliminate wood from foundations, cellars and basements. This means the substitution for wood of concrete or other stone equivalent for basement floorings, as well as the elimination from basements of any other structural wood, including wood substitutes, such as fiber and composition boards and other substitutes containing cellulose. This prohibition does not apply to movable furniture.

Timber or lumber can be used safely in buildings if it is raised above possible soil contact a suitable distance by rock, concrete, or brick foundations made with standard grades of mortar, or suitably capped, and if metal shields are put on to shut off passage-tubes.

A few hundred dollars additional (2 per cent of the first cost) spent in the beginning in proper building construction may save you thousands of dollars in repairs and replacements later. It is much simpler and cheaper to keep termites out of a building than to get rid of them and repair the damage after they are once in. The necessary repairs may be too costly for the small householder. But certain methods of construction that will prevent injury are entirely practical.

Here are some suggested regulations for preventing termite attack which should be made a part of city building codes:

1. Wood or fiber products, when an approved preservative has not been forced into the product, shall not be placed in the earth or within 18 in. thereof, excepting wood columns or posts over a concrete floor, which columns shall be provided with non-corroding metal or concrete base plates or footings 6 in. above the floor. This applies to steps, which shall be laid over a concrete base, projecting at least 6 in. beyond the supports of the steps.
2. Timber to be used in contact with the earth shall be thoroughly impregnated by a standard-pressure process with coal-tar creosote or other equivalent preservative. Timber should be completely cut to proper dimensions before treatment, whenever possible, but when cutting after treatment is unavoidable, the cut surfaces shall be thoroughly coated with coal-tar creosote or other equivalent preservative.
3. Masonry foundations and footing shall be laid in portland-cement mortar. Foundations built up of masonry units, whether hollow or solid, shall be capped below woodwork with at least 1 in. of portland-cement mortar, or the mortar and slate, or solid of joined non-corroding metal, or other equally efficient seal.
4. In the case of frame buildings, a metal termite shield shall be provided, continuing completely around the top of the masonry foundation, including all pillars, supports, and piping, below the woodwork of the building, on both the inside and outside surfaces. Such a shield may be formed of a strip of non-corroding metal (such as copper, or zinc,

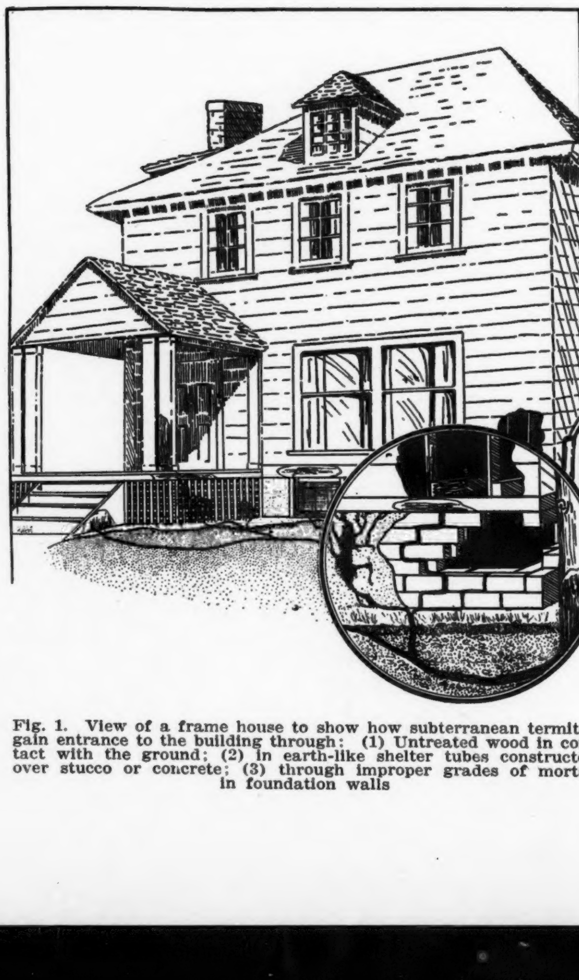
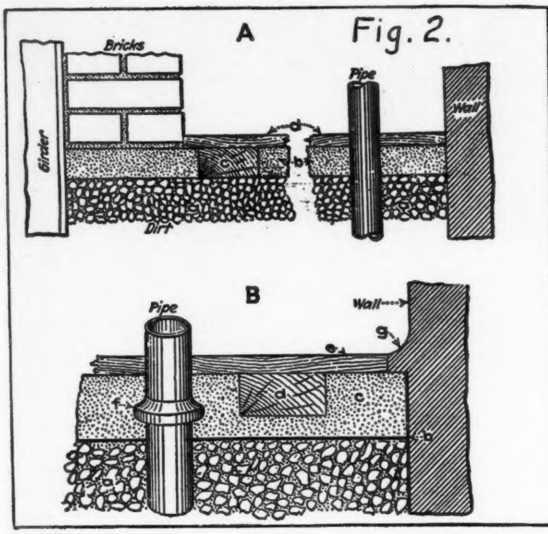


Fig. 1. View of a frame house to show how subterranean termites gain entrance to the building through: (1) Untreated wood in contact with the ground; (2) in earth-like shelter tubes constructed over stucco or concrete; (3) through improper grades of mortar in foundation walls

[1]Paper presented at the structures session of the 22nd annual meeting of the American Society of Agricultural Engineers, at Washington, D. C., June, 1928.

[2]Entomologist, division of forest insects, bureau of entomology, U. S. Department of Agriculture.



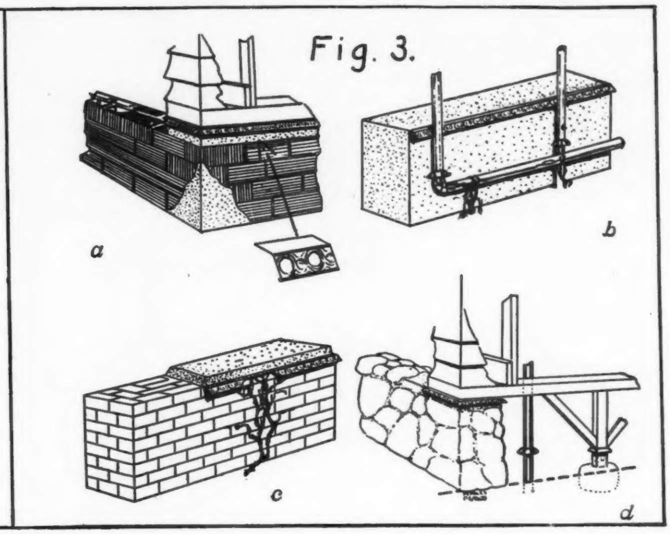


Fig. 2. A, (above) improperly constructed concrete flooring: a, gravel or cinders loosely cemented with coarse concrete, 3 in. thick, but with many crevices and holes; b, solid, dense concrete, 2 in. thick; c, 2x4-in. untreated wood sleeper set in moist concrete over the grout; d, ⅞-in. pine flooring nailed to sleepers. B, (below) properly constructed concrete flooring: a, gravel or cinders loosely cemented with coarse concrete, but with many crevices and holes; b, asphalt waterproofing ⅛ in. thick; c, dense concrete, 3 in. thick; d, 2x4-in. treated wood sleeper set in a groove in concrete which insulates it from termites in the earth; e, ⅞-in. flooring nailed on sleepers; f, metal collar around pipe which runs down through the concrete (This collar should be soldered to the pipe and embedded in the concrete; g, shoulder of concrete at point of wall and concrete floor to avoid a right-angle connection and consequent cracking

Fig. 3. The insulation of hollow and solid masonry foundation units against termites: (a) Foundation wall of hollow tile surfaced with stucco, showing metal termite shield in place and how the top of the wall is capped with sheet slate and concrete; (b) concrete wall with termite shield at top and horizontally laid piping fitted with metal shield above bend to shut off termite tubes; (c) brick wall with termite shield and capped with concrete (Note how the shield mechanically blocks the earth-like shelter tubes of the termites.); (d) stone wall with termite shield and capped with concrete and wooden posts insulated from the ground with base stone and concrete block. Note termite shields on post and piping

or an alloy composed of 28 per cent of copper, 67 per cent of nickel, and 5 per cent of iron, manganese, and silicon), firmly inserted in the surface of the masonry, or between the foundation and the wood, with the projecting edge bent downward at an angle of 45 deg. and extending horizontally at least 2 in. from the face of the foundation. In masonry buildings this shield can be inset in masonry at a height at least 18 in. above ground.

5. Floor sleepers or joists imbedded in masonry or concrete, or laid on concrete which is in contact with the earth, shall be impregnated with an approved preservative.

6. Expansion joints between concrete floor and wall shall be filled with liquid asphaltum and the right-angle joint covered with a sanitary cement mortar or portland-cement concrete finish of an arc of at least 2 in. in length.

7. The ends of wooden beams or girders entering masonry or concrete shall not be sealed in but shall be provided with boxes affording an air space at the end of the piece of not less than 1 in. at side of member, unless the ends of such timbers are impregnated with coal-tar creosote or other approved preservative.

8. Where there are spaces under floors near the earth, they shall be excavated so that there will be no earth within 18 in. of the wood, and they shall be provided with cross ventilation. Such ventilating openings shall be proportioned on the basis of 2 sq. ft. for each 25 lineal feet of exterior wall, except that such openings need not be placed in front of such building. Each opening shall be provided with 20-mesh non-corroding metal screening, including windows in attics.

9. Where timber is used in roofs of the flat type, the roof shall, unless protected on the weather side with a waterproof covering, have a slope and run-off sufficient to provide proper drainage.

10. All wooden forms on foundations shall be removed from masonry work within 15 days; grading stakes should be removed before laying concrete floors.

To locate termite damage, at once look over carefully all woodwork touching or near the ground to find out how the termites get in. Discover where the flying forms came out of the woodwork. This will indicate where the workers are in the wood. Often you will find large numbers of dead winged termites or the shed wings nearby.

When you try to stop further damage by termites in buildings you should realize that their numbers may be constantly increased from some undiscovered outside nest. Killing the swarming winged adults, although it may prevent the founding of new colonies, will not stop the damage to the woodwork by the workers inside.

Another warning that termites are around is the branching shelter tubes on foundation timbers or other woodwork, or reaching from the ground to the woodwork over the surface of stone, brick, or other foundation material through which the termites can not burrow.

In repairing termite-damaged buildings use the same suggestions as for the construction of new buildings. If you do so you can get rid of termites in buildings where they are already working.

Disconnecting wood from the ground will save time and expense, especially in the case of old frame buildings where extensive repairs would not be practicable. When you disconnect untreated foundation timbers from contact with the soil, the termites in the other woodwork, furniture, and stored material in the building will also die, even if they have reached the second or third floors. Timbers structurally weakened so as to endanger the buildings, or disfigure the woodwork, of course should be removed. However, if the wood is kept moist by some other means, such as water leakage, the termites will continue to work. This applies especially to damp corners of basements near outside water pipes, bathrooms, kitchens, and the like.

Wooden floors laid directly on the ground, or on tar or tar paper, or on beams on the ground, or set in concrete, should be removed. There should be a layer of concrete, or of some other artificial stone effectively sealed with proper mortar or concrete, between the earth and the wood.

A frame building need not be raised or jacked up to cap the wall, but the upper tier of bricks can be removed, a few at a time, and the wall capped.

Where poor grades of mortar have been used in masonry walls below the ground, it may be necessary to coat the

outside or inside of the wall with portland cement or concrete to prevent termites from boring through.

Metal termite shields can be inserted over the masonry foundations of buildings already constructed.

AUTHOR'S NOTE: For a more complete description of termites and their habits, see Farmers' Bulletin 1472 of the U. S. Department of Agriculture.

Discussion

MR. DICKERSON: Is open tank creosoting a good protection against termites?

DR. SNYDER: The open tank method is perfectly satisfactory in some places but not in all parts of the country. We recommend the pressure method.

MR. LYLE: Will termites go over a concrete shield at a 45-deg angle?

DR. SNYDER: Yes. Metal seems to be the only good material from which to make these shields, and painted metal is not so good as unpainted. Copper, monel metal or zinc, which are weather-resisting metals, are best to use.

MR. KAISER: How rapidly do the termites work?

DR. SNYDER: They will damage the sills and posts under a building in a few weeks.

MR. KAISER: How rapidly will they tunnel to a house from a fence post near by?

DR. SNYDER: In six months a new house may become badly infested. They work faster in summer and would probably only require a few months.

MR. KAISER: How long can they make these tubes through which they work?

DR. SNYDER: They have been known to go as high as 25 ft. up a cocoanut tree.

QUESTION: Do they attack furniture only when attached to the floor?

DR. SNYDER: The dry wood termites of the Southwest attack movable furniture. They do attack some live trees, but not in the United States. They prefer dead wood.

QUESTION: How do you control dry wood termites in furniture?

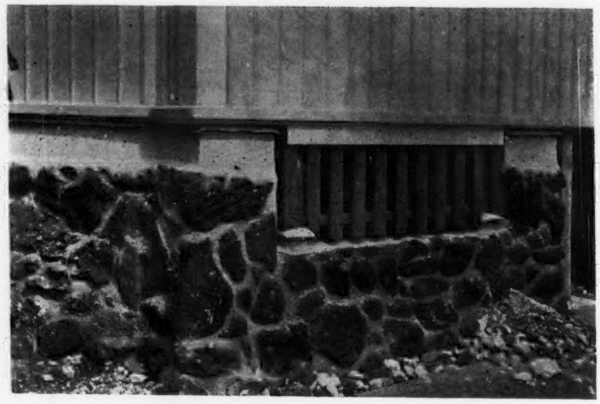


Fig. 4. A view of metal termite shields in place upon a building

DR. SNYDER: By fumigation or by a 130-deg. temperature, this method being used by the railroad companies on their cars in Hawaii and the tropics.

MR. KAISER: Is the damage by termites on the increase, or is it decreasing?

DR. SNYDER: It is on the increase, due to the fact that the natural balance had been disturbed and the termites are attacking man-made structures more and more in the absence of natural objects.

MR. FENTON: Do termites live in all types of soil, or do they have a preference?

DR. SNYDER: They do not live in very alkaline soils or near the sea beach where it is salt.

MR. DICKERSON: What control measures are effected against the power post beetle?

DR. SNYDER: Power post beetles are commonly found in the lake states, but their control is very simple. Most any paint, even whitewash, applied carefully enough to close the pores is a protection.

New Machine to Help Solve Dockage Problem

AFTER many years of research and experimentation a new disk recleaner for use on the decks of threshing machines for removing weed seeds and other dockage from grain as it is threshed has been perfected and is available to threshermen and farmers of the "Dockage Belt" for the coming harvest season. With the development of this recleaner, the four-fold advantage of cleaning grain on the farm is secured for the farmer himself, rather than the local or terminal elvator or flour mill.

By cleaning his grain as it is threshed, the grain grower automatically secures a valuable feed for his livestock, raises the grade of the grain, thus materially increasing the price per bushel which he receives, saves the money he has been paying to ship the dockage to market, and secures a weed-free seed supply for the next crop.

Portable recleaners have been available for some time, but many grain growers have not had the bin facilities or the desire to clean their grain before hauling it to market. The deck recleaner should remove this objection to dockage removal on the farm.

One of the chief obstacles formerly in the way of cleaning grain at the threshing machine was the unwillingness of the grower to pay the custom thresher for removing the dockage that came through the machine with the grain, while the thresherman was naturally unwilling to provide the extra equipment and remove the dockage for nothing. Recent investigations, however, show that this attitude is changing, while the rapid increase in individually owned threshers has also changed the complexion of the problem. The National Bureau of Dockage Investigations in cooperation with the U. S. Department of Agriculture last winter conducted an extensive survey which brought to light some interesting facts. Of nearly 3,000 farmers answering the questionnaire, 99.3 per cent reported that they clean their grain for seed, thus exploding the popular fallacy that many grain growers sow weedy seed. Forty-four and five-tenths per cent clean some or all of their grain for market. Some of these remarked that they clean their grain if they have time or if the dockage is sufficiently heavy to warrant it. Out of the 2779 reporting, 1428 own threshing machines. Sixty-three and two-tenths per cent of this number have rigs with 28-inch or smaller cylinders, another indicator of the popularity of the individually owned thresher.

Here is an outstanding fact, and it has an important bearing on the demand for recleaning facilities. Of the 1428 thresher owners, 81.6 per cent believe they would have an advantage over other threshermen if they could remove dockage as they threshed. Farmers not owning threshers emphatically indicated that they would like to have their grain so cleaned. The majority of the threshermen set 2 cents per bushel as the charge they would make while almost the same percentage, or 51.6 per cent of the farmers set 2 cents as the bushel charge that they would be willing to pay.

Effect of Drawbar Pull Upon the Effective Weight on Front and Rear Wheels of Farm Tractors

By E. G. McKibben[1]

THE following simplified formulas, for the effect of the magnitude and location of the drawbar pull upon the supporting soil reactions against (same numerical value as the effective weights on) the front and rear wheels of a wheel-type tractor, should be of interest to those who are in any way connected with the practical application of this type of farm tractor. While many tractor mechanics, salesmen and farmers may have difficulty in comprehending all the theoretical mechanics involved in the complete analysis of all the force reactions against a tractor, they should be able to easily memorize and readily apply the following formulas.

The stability, steering characteristics and tractive ability of a tractor, under any given condition, are controlled by the supporting soil reactions against (same numerical value as the effective weight on) the front and rear wheels, respectively. Therefore, it is highly desirable that those interested in the tractor either from the sales, operation, or maintenance viewpoint have a clear conception of the effect of any given drawbar pull and hitch adjustment upon the supporting soil reaction against the tractor's wheels.

NOTATION

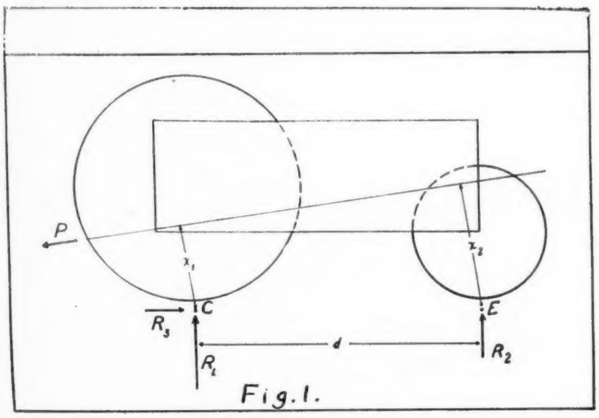
C, point of intersection of lines of action of R_1 and R_3
E, point of intersection of lines of action of R_2 and R_3
P, drawbar pull
R_1, resultant of supporting soil reactions against the rear wheels, and numerically equal to the effective weight on the rear wheels
R'_1, numerical change in R_1 due to P
R_2, resultant of supporting soil reactions against the front wheels, and numerically equal to the effective weight on the front wheels
R'_2, numerical change in R_2 due to P
R_3, resultant of tractive soil reactions
d, effective wheelbase
x_1, perpendicular distance from C to the line of action of P
x_2, perpendicular distance from E to the line of action of P

[1]Assistant professor of agricultural engineering, University of California. Mem. A.S.A.E.

Front Wheels. By taking moments about point C of Fig. 1, it can be proved by established principles of mechanics that the numerical change, R'_2, in the supporting soil reaction, R_2, against, or the effective weight on, the front wheels, caused by the drawbar pull, P, will be numerically equal to $\frac{(Px_1)}{d}$, that is

$$R'_2 = \frac{Px_1}{d} \quad \text{.......................(1)}$$

It is also evident that, if the line of action of the drawbar pull passes above the point, C, as in cases Nos. 1, 4, 9, 10 and 11 of Figs. 2, 3 and 4, the effective weight on the front wheels will be decreased by an amount equal to $\frac{Px_1}{d}$; that, if the line of action of the drawbar pull passes through point C as in cases Nos. 2, 5 and 12 of Figs. 2, 3 and 4, the effective weight on the front wheels will remain unchanged; and that, if the line of action of the drawbar pull passes below point C as in cases Nos. 3, 6, 7, 8 and 13 of Figs. 2, 3 and 4, the effective weight on the front wheels will be increased by an amount equal to $\frac{Px_1}{d}$.



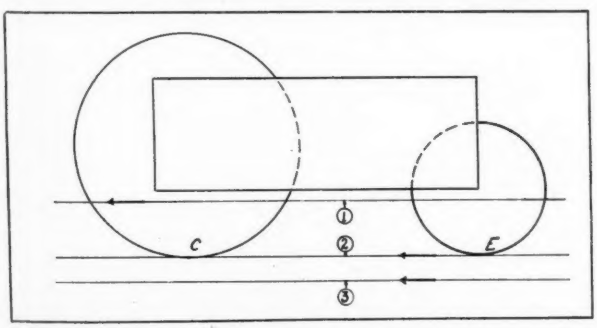


Fig. 2. Showing points of application and lines of action of drawbar pulls in Tests 1 to 3 of Table I

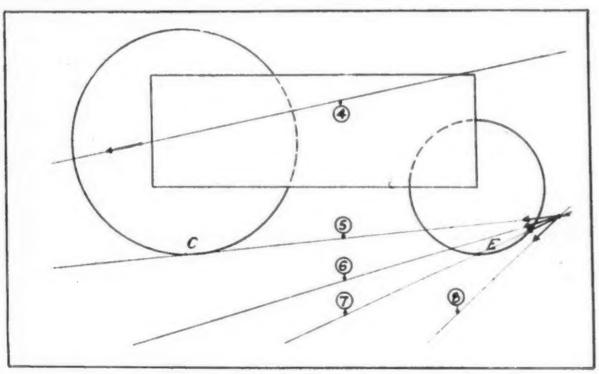


Fig. 3. Showing points of application and lines of action of drawbar pulls in Tests 4 to 8 of Table I

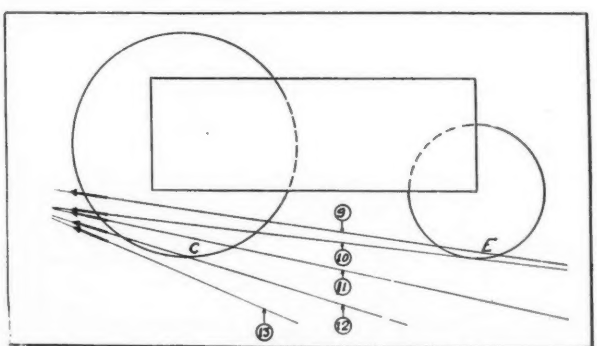
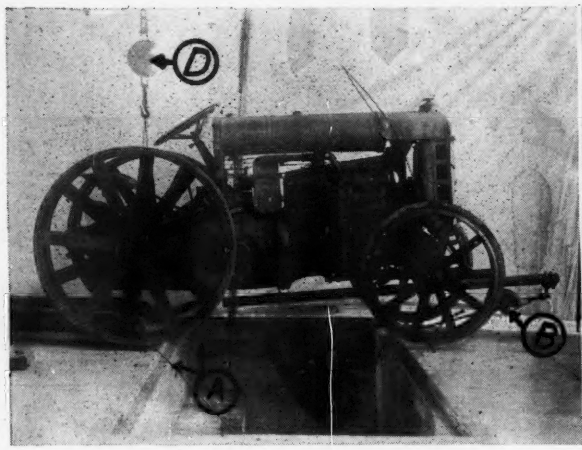


Fig. 4. Showing points of application and lines of action of drawbar pulls in Tests 9 to 13 of Table I



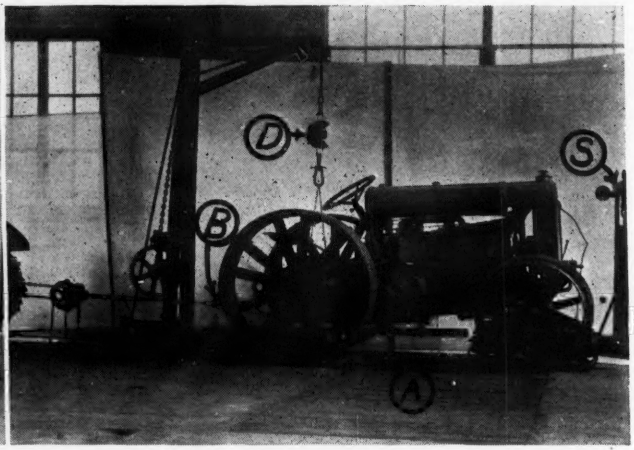


Fig. 5. (Left) Apparatus and set-up used in Tests 2, 3, and 5 to 8 of Table I Fig. 6. (Right) Apparatus and set-up used in Tests 1, 4 and 9 to 13 of Table I

Rear Wheels. Likewise by taking moments about point E of Fig. 1 it can be proved that the numerical change, R'_1, in the supporting soil reaction against, or the effective weight on, the rear wheels, caused by the drawbar pull, P, is numerically equal to $\frac{Px_2}{d}$, that is

$$R'_1 = \frac{Px_2}{d} \qquad (2)$$

It follows that if the line of action of the drawbar pull passes above point E as in cases Nos. 1, 4, 5, 6 and 9 of Figs. 2, 3 and 4, the effective weight on the rear wheels will be increased by an amount equal to $\frac{Px_2}{d}$; that, if the line of action of the drawbar pull passes through point E as in cases Nos. 2, 7 and 10 of Figs. 2, 3 and 4, there will be no change in the effective weight on the rear wheels; and that, if the line of action of the drawbar pull passes below the point E as in cases Nos. 3, 8, 11, 12 and 13 of Figs. 2, 3 and 4, the effective weight on the rear wheels will be decreased by an amount equal to $\frac{Px_2}{d}$.

Laboratory Check. These formulas were checked as shown in Figs. 5 and 6. The tractor engine was locked. The tractive soil reaction was supplied by cables (A, Figs. 5 and 6) which were fastened to the rims of the rear wheels and anchored to the floor. The drawbar pull was measured by the indicating dynamometer, B, and the effective weight on the rear and front wheels before and after applying the load was determined by the use of the indicating dynamometer, D, and the scale, S. The points of application and the lines of action of the drawbar pulls used are shown in Figs. 2, 3 and 4. The results which are given in Table I check well within the error which might be expected from the rather crude apparatus used.

Graphical Solution. Fig. 7 shows a graphical solution of Equations 1 and 2 for values of d from 10 to 100 in. and values of x from 0 to 50 in.

SUMMARY

1. The change in effective weight, in pounds, on the front wheels of a tractor is numerically equal to the product of the drawbar pull in pounds times the distance, x_1, (Fig. 1) in inches, divided by the effective wheelbase in inches. Using the symbols of Fig. 1 and its notation, this change is equal to $\frac{Px_1}{d}$.

2. If the line of action of the drawbar pull passes above

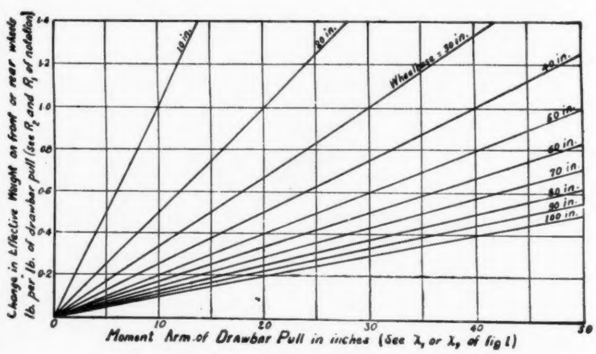


Fig. 7. Graphical solution of Equations 1 and 2

TABLE I

Test No.	d, in.	P, lb.	x_1, in.	x_2, in.	$\frac{Px_1}{d}$ lb.	R_2 Before lb.	R_2 After lb.	R'_2 lb.	$\left(\frac{Px_1}{d}\right) - R'_2$ lb.	$\frac{\left(\frac{Px_1}{d}\right) - R'_2}{(R_1 + R_2)}$	$\frac{Px_2}{d}$ lb.	R_1 Before lb.	R_1 After lb.	R'_1 lb.	$\left(\frac{Px_2}{d}\right) - R'_1$ lb.	$\frac{\left(\frac{Px_2}{d}\right) - R'_1}{(R_1 + R_2)}$
1	63	2000	12.4	12.40	394	1018	615	403	—9	—0.0035	394	1540	1930	390	4	0.0016
2	63	2000	0.0	0.00	0	1025	1015	10	—10	—0.0040	0	1460	1440	20	—20	—0.0080
3	63	2000	5.25	5.25	167	1025	1170	145	22	0.0088	167	1460	1320	140	27	0.0109
4	63	2000	25.9	39.70	822	1018	208	810	12	0.0047	1260	1540	2810	1270	—10	—0.0039
5	63	2000	0.0	6.15	0	1025	1020	5	5	0.0020	195	1500	1690	190	5	0.0020
6	63	2000	16.1	2.40	502	1040	1525	485	17	0.0068	76	1475	1570	95	19	0.0075
7	63	2000	27.1	0.00	860	1040	1920	880	—20	—0.0080	0	1475	1480	5	—5	—0.0020
8	63	2000	51.5	6.30	1635	1040	2670	1630	5	1.0020	200	1475	1260	215	—15	—0.0060
9	63	2000	10.5	1.60	333	1018	670	348	—15	—0.0059	54	1540	1610	70	—16	—0.0063
10	63	2000	7.0	0.00	222	1018	800	218	3	0.0011	0	1540	1545	5	—5	—0.0019
11	63	2000	4.3	8.60	137	1018	883	135	2	0.0008	272	1540	1250	290	18	0.0070
12	63	2000	0.0	18.80	0	1018	1022	4	—4	—0.0016	995	1540	955	985	10	0.0039
13	63	2000	3.46	29.20	110	1018	1140	122	—12	—0.0047	925	1540	630	910	15	0.0059

Point C of Fig. 1, the effective weight on the front wheels will be decreased.

3. If the line of action of the drawbar pull passes below Point C of Fig. 1, the effective weight on the front wheels will be increased.

4. The change in effective weight in pounds on the rear wheels of a tractor is numerically equal to the product of the drawbar pull in pounds times the distance, x_2, (Fig. 1) in inches, divided by the effective wheelbase in inches. Using the symbols of Fig. 1 and its notation, this change is equal to $\frac{Px_2}{d}$.

5. If the line of action of the drawbar pull passes above Point E of Fig. 1, the effective weight on the rear wheels will be increased.

6. If the line of action of the drawbar passes below Point E of Fig. 1, the effective weight on the rear wheels will be decreased.

Extension Methods for Rural Electrification[1]

By H. B. Walker[2]

FIVE years ago little was known of rural electrification. At that time very few had made a systematic study of the problems involved in extending electrical service to rural dwellers. Moreover, our conceptions of rural service were very vague. We were inclined to think of it more or less as a luxury; something very desirable for those who could afford it, but few thought it ever could be made to pay its way in service to the farm consumer or in investment return to the utility.

Many changes have occurred since that time. The systematic studies inaugurated through the state experiment stations by the national Committee on the Relation of Electricity to Agriculture have developed a wealth of information. These studies have had a tremendous influence on public opinion also. Today we think of farm electrification in tangible terms, and the idea is rapidly gaining headway that electrical service in rural communities is not only possible, but necessary for the social and economic development of rural life.

The approach to the rural electrical problem has been logical. The preliminary work has been confined to fact-finding studies which have shown the status as well as the possibilities of rural service in the various states. These studies have been conducted through agencies having a nonpartisan interest, and fortunately data have been developed of tremendous interest to both the producer and consumer of electrical energy. It would not be fair to say that all of the problems in rural service have been solved, or that all of the questions have been answered, but enough has been done to show beyond question the practicability of supplying and utilizing that service to and in rural communities.

The next important step in the rural electrical program is the initiation of a comprehensive extension program based upon the data already developed, which will bring to the attention of rural dwellers and utility companies the conditions under which such service may be extended into new areas.

The first essential in any successful extension program is the development of subject matter material. The various state projects through their research programs have developed an enormous amount of data which may be used as the basis of subject matter material for extension programs. These data, however, are not as yet all interpreted into a form to be most useful for such purposes. It is true that many excellent publications are available, but these, for the most part, are of the fact-finding type. They are neither for or against. They do not tell how to proceed. They do not arouse sufficient interest in development programs; neither do they suggest positive action.

No criticism can be made of our present publications on this subject. They are the logical result of a research program. They are what they should be for getting our setup of the problem, but, if active extension programs are desirable, we must take our research subject matter and translate it into terms which will stimulate potential consumers to become the beneficiaries of the useful knowledge developed, and into information which will enable the utility to reach these consumers in a logical and economical manner.

Fortunately, the rural electrical problem is one which cannot be successfully exploited by either of the principals involved to the detriment of the other. The utility cannot be successful in its rural service program without satisfied consumers, and, furthermore, the consumer cannot hope for satisfactory service unless the utility can afford to furnish the customer proper service. This fundamental relationship has been a great factor in the very satisfactory progress which has characterized our research program. The same idea must be injected into extension programs.

Those who have carefully studied rural service know that electric lights have commercial value in poultry house lighting, dairy barns and other farm buildings. The advantages of electric pumping, farm refrigeration, washing, ironing, milking, grinding, irrigating, elevating grain, etc., are known, and these may be expressed in tangible values. Our research data indicate that these and many other services can be successfully and economically utilized on many farms. The initial step, then, in the extension program is to translate these data into a program of procedure based upon the assumption that farmers will pump water, milk cows, grind feed, wash and iron clothes, and elevate grain with electrical energy. In other words, the successful extension program must be directed toward a positive goal. The preparation of extension circulars and bulletins on specific uses of electricity on the farm is the first and primary step in attaining this goal.

Three agencies are involved in a well-balanced rural electrical extension program. Two of these are directly concerned, and the third indirectly. These agencies are (a) the utility, (b) the farm consumer, and (c) the related educational agencies. The first two must have, to a degree at least, a partisan interest to successfully meet their problems. The third, or educational interest, must be nonpartisan and based entirely upon general public welfare and agricultural progress.

The educational institutions, especially the extension divisions of the land grant institutions, should take an active part in rural electrical extension programs. The preparation of extension circulars and bulletins, radio programs, newspaper articles, public meetings, and special schools, all come within the realm of agricultural extension activities. It is the specific function of such agencies to create interest and desire, or perhaps a better way to express it would be to say, stimulate thought in agricultural progress. The extension agencies of public institutions, however, cannot go beyond this stage. They do not have, and should not attempt to set up directly, the agencies to satisfy the specific desires created. They should have, however, a deep interest in the agencies which really sell the service. The educational extension program which does not take this into account is not complete.

The utility company and related commercial agencies must be able to satisfy the requirements of the rural customer. This cannot be done by haphazard methods. Rural service in many respects is unlike that supplied to other consumers. The applications are somewhat different and the industry served is a decentralized one with many units of management. The approach to the business must be such as to

[1]Paper presented at the rural electric session of the 22nd annual meeting of the American Society of Agricultural Engineers, at Washington, D. C., June, 1928.

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inspire community confidence and promote understanding between two great industries which are fundamentally different in management and operation. For these reasons it appears essential for the utility to establish rural service or farm departments under the direction of men who are in sympathy with the objectives of the agricultural industry, yet who have sufficient technical background to enable them to build up a service with economic stability.

The agricultural industry with its diversity of management is probably our most sensitive industry. On the other hand, it is one of the most loyal to those in whom it has confidence. Farmers appreciate fair dealing. They may be cautious in taking up new things and they may not respond to the usual business approach in the sale of electric service, but farm service undoubtedly can be hastened if the farm business is developed through special departments placed under the management of properly trained men.

These men must have a peculiar selling knack. They must be careful not to oversell the customer, and at the same time they must recognize that the success of the venture for the utility depends upon the early establishment of volume of service. These factors are mentioned not to point out the qualifications of the individuals making up a department, but to emphasize the necessity of organized farm departments in our utility companies if farm service is to be logically and safely expanded. The second step then in a well-organized extension program in rural electrification is the establishment of rural service departments by our public utility corporations.

The cooperation of our land grant college extension workers with these rural service departments is essential for logical growth. Surely no public agency is as close to farm folks as the agricultural departments of our land grant colleges. These institutions are really the research agencies of the agricultural industry. The organized extension service of these institutions is the agency which caries the results of research to farms and rural homes. These agencies will be called upon to render service in extending electricity to rural communites because agriculture naturally looks to them for aid.

As has already been pointed out, this extension service must of necessity be educational in its nature. The commercial phases of the program must be carried out by private agencies. The utility company which establishes a rural service department gains favor from the agricultural industry because this is a distinct recognition of the industry to be served and, moreover, it indicates a special effort to logically meet the farm electrical problem. Moreover, it enables the educational program of our land grant schools to be carried out in a more logical manner. It forms a contact between the utility and the extension service of our state institutions. The extension workers from our colleges can never hope to make direct contacts with the hundreds of farmers desiring rural service. This direct contact will and must be made by the company representative who sells the service. The function of educational extension effort at this particular time is to develop a correct approach to the farm business. This approach will be a combination of education and business which can be developed best by bringing these workers together for a blending of objectives.

The practice already started in a number of states of holding schools for utility men engaged in rural electrical service is a splendid one. Such schools do more to bring about a unity of understanding between our educational and commercial workers than any other single factor. This, in turn, enables the educational extension program to be more effectively carried out, and it develops a sounder growth in rural electrical extensions. Such schools are not without precedent in other lines of work. Lumber dealer schools, metermen's schools, dairymen's schools, and many others are annual events in a large number of our land grant institutions. These will give unity to extension efforts by providing a common viewpoint and better directed effort in sound policies for rural service extensions. The third step, then, in our extension program should be the holding of special extension schools for the representatives of rural service departments. These schools should take up farm problems as well as those peculiar to the utility. So much new information is being developed in agricultural fields by research and experimentation of interest in rural electrification, that it is believed such special schools could very profitably be annual events.

The fourth stage of a well-planned extension program has to do with the farm customer. To get the farmer to utilize electrical energy in volume is a problem which will require careful and persistent effort on the part of the utility field men. In this effort they must be aggressive without using the so-called high-pressure salesmanship methods. The fact that volume of energy consumption is the secret of success both for the farmer and the utility, calls for action which will bring ultimately positive results, both to the producer and the consumer. Half-way methods and questionable service will not build up the business. Neither will limited utilization or cheap equipment bring satisfaction to the consumer. This is a situation which requires considerable money expenditure by the consumer before adequate returns can be enjoyed either by the consumer or the utility.

Rural service departments have a very difficult situation to face. They must, and undoubtedly do, realize that inadequate wiring spells dissatisfaction to the consumer before a satisfactory farm load is built up. They also must face the situation that heavy initial expenditures in good wiring systems reduce the available money for energy-consuming equipment. Apparently there is but one course to follow, and that is to proceed on a quality basis and go just as far as possible. To attain this, the influence of educational workers is desirable. A good secondary wiring system is an important part of the foundation of satisfactory farm service. It should be installed with the idea of ultimately taking care of the volume load. With such a foundation on the farm, it is easier to build up particular services.

There is no type or kind of farm power requiring fewer apologies than electric power. Being such, its uses in agriculture are readily demonstrated. The demonstration method of introducing new practices in agriculture is a most effective extension method. If it is based on a method or process, such as silo filling, milking cows, pumping water, or elevating grain, and without reference to a specific machine, it may be conducted in conjunction with educational extension programs. Such programs must be carefully worked out, but they may be very effectively used in building up the farmer's interest.

These demonstrations should be of two types. The first should relate to methods and processes in which the assistance and cooperation of educational agencies should be sought and utilized, and then these should be followed by specific demonstrations with machines or equipment by commercial agencies, since these, after all, must close the contract which brings the actual service to the consumer.

The fourth essential step in our extension program, then, must be largely made up of demonstrations to show the farmer the specific applications to his business. These should be centered first around the more common applications where failure of satisfactory service is practically impossible. These then will pave the way to newer and more unusual applications because the confidence of the farm customer will have been built up by logical methods.

The four important steps in a logical extension program in rural electrification may be summarized as follows:

1. The preparation of subject matter in popular form based upon the research data of our field studies and presented in positive terms for good farm practice.

2. The establishment of rural service departments by our public utility companies for the purpose of promoting the farm business in a safe and logical way.

3. The training of rural electrical representatives and extension workers by holding special schools to bring about effective methods of extending rural service to farms.

4. The demonstration of specific service to farm consumers by two methods: (a) The general demonstration in cooperation with educational programs in which methods or processes are shown, such as electric cooking, refrigeration, silo filling, etc., and (b) specific demonstrations of electric equipment by commercial agencies.

Labor Economy in Dairy Management[1]

By I. F. Hall[2]

THERE has been no time in history when the saving of labor on farms has been as important as during these last few years of what is known as the "agricultural depression." Manufacturing industries have accomplished somewhat more than has agriculture in the economical use of labor. Yet the large industrial centers have been continually demanding more workers and are actually moving them from the farm to the cities at wages far in excess of those the farmer can pay.

With this scarcity of labor on farms getting more and more acute each year since 1920, it has brought about the use of more and better labor-saving machines on farms. Most of us are fully acquainted with these labor-saving machines and what they have accomplished in reducing the number of men required to produce the foodstuffs of our country.

Due to the increasing demands for fluid milk by the cities many butter and cheese sections of the country have been called upon to supply this increase. Many farmers have been asking for suggestions in rearranging their buildings to meet the board of health recommendations. A study was made on nearly 1000 farms making detailed measurements on the arrangement and layout of all farm buildings with suggested changes the farmer would like to make to satisfy his preference in every detail.

As a result of this study we found that many of our dairy barns are in a bad mess and much labor is wasted in unnecessary travel from one operation to another. The building arrangement may not be the most important problem on farms, yet on a dairy farm it should have more careful planning. According to time records, a farmer spends more hours caring for a cow than for any other animal and more time than he expends in caring for a whole acre of any crop he grows.

Many of the poorly arranged buildings now found on farms are not the planning of the present owner, but are the accumulated efforts of many past operators who have attempted rearranging and as a result we see today farmsteads with many small buildings with additions, lean-tos, ells, etc.

One has to visit but few barns to find many examples of bad location of silos, granaries, hay chutes, milk houses, etc. One stops and wonders how a man would do such things. A great many farmers are so used to working around in a barn with these disadvantages that they never notice it. Others realize the extra time consumed each day, but the time of making the desired changes is greater than the extra time spent each day; so they go on day after day and year after year carrying grain in a bushel basket from the granary above, across the barn floor, down a flight of stairs to one end of the stable to feed the cows at the other.

This is quite common on many dairy farms. On one farm, after measuring the distance traveled and computing this for only one year, it was found that this dairyman in feeding 40 cows, grain alone, walked the equivalent of from New York City to Chicago and back again, and the distance going up and down the stairs was equal to walking to the top of the Woolworth Building in New York City and back again seven times. A bushel basket may be all right to use in feeding five or six cows, but not for feeding forty. This man has made a chute to the basement in the feeding alley and now feeds the cows in one quarter of the time. A conveniently arranged feed storage is quite necessary on a dairy farm. This should be on the floor above the stable with sufficient space for mixing, with a chute leading to the feeding alley below.

The location of the milk house is many times decided by some whimsical milk inspector and ever after has made many extra miles of travel. On the farms visited 10 per cent of the milk houses were inside the barn, 46 per cent were adjoining the stable, and 44 per cent were built at an average distance of 81 ft. from the stable with a variation from 4 to 160 ft. Every 4½ ft. that the milk house is placed from the stable means one mile travel per cow per year. A distance of 81 ft. makes 18 mi. travel per cow per year if the milk is strained in the milk house. Many of the silos are built with little thought as to the convenience in filling or feeding. I have seen silos being filled when, after the wagon is unloaded, the rig must be backed away from the ensilage cutter before another team can drive up. Almost as much time is used to get away from the machine as it takes to unload. This same silo was at one end of an 80-ft. barn with the cows across the other end. All the silage was carried in a potato crate to each cow the length of this barn. This man is now using a feed cart which saves a great many trips. A silo should be located near the feeding alley with a feed cart so constructed that it can be pushed

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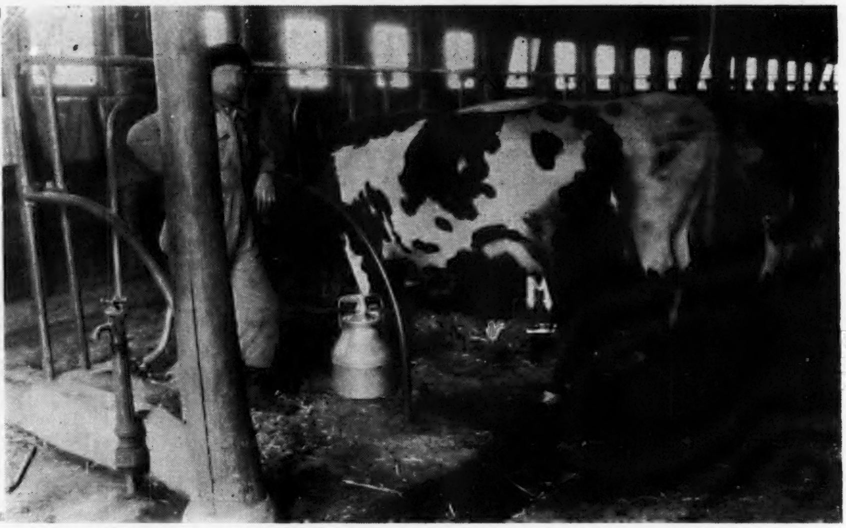
There is a real demand from farmers for effecting greater labor economy in dairy management. This calls not only for the use of more and better labor-saving equipment, but also for better design of dairy barns. Here is a pressing problem indeed for the agricultural engineer

Shall Cows Face In or Out in the Modern Dairy Barn?

The question of whether cows should face in or out is pretty well answered by the farmers themselves. The result of Mr. Hall's studies shows that 90 per cent of the farmers visited prefer to have the cows face out with a driveway between the rows enabling them to clean the stables with one handling of the manure. Also milking machines can be operated more easily with this arrangement



into the silo chute so that when the ensilage is thrown out it will load the cart. Records on 1139 farms show that 665 had silos; 70 per cent were located on the side of the stable and 30 per cent at the end of the barn. Where no feed cart is used, the most convenient place for a silo is on the side of the stable in the middle of a row of cows, but where one uses a cart there is little preference as to the location as long as it is next to the feeding alley.

There are over thirty equipment companies and most of them have men in their employ who furnish building plans. I am sure much help has been given by these companies in better barn designing, but there are many cases where it would appear that the object of designing the buildings has been to so arrange them that as much equipment could be sold as possible.

Before building a new barn or rearranging an old one, a person should make floor plans and trace the lines of travel which will be covered in doing chores. Mistakes in the purchase of a cow can easily be rectified or a mistake in planting a particular crop affects the farm for that year only, but when a mistake is made in building arrangement it is very serious because it lasts a long time and is not easily changed.

A barn 36 ft. wide is most commonly preferred by dairymen although 34 ft is fairly satisfactory, but most of the new barns now being built are 36 ft. wide. This width seems to be best suited to all kinds of stock and such a barn can easily be converted into a sheep barn, feeding barn, or hen house.

There is much discussion among barn designers and professional men as to the question of whether cows should be faced in or out. The farmers discuss this question very little, but the result of my studies shows that 90 per cent of the farmers visited prefer to have the cows face out with a driveway between the rows enabling them to clean the stables with one handling of the manure. In a time study made on about one hundred of these farms with herds of equal size, it was found that it required 35 min. per day to care for each of the cows when they face in. When they face out it required 30 min., or a serving of 5 min. a day for each cow in the herd.

The advantages of facing cows in are as follows:

1. Easier and quicker to feed.
2. The posts in the basement are not in the way. The posts supporting the cross timbers can be placed at the stanchion curb. This makes the spacing across the barn of about equal distance. When cows face out the posts come near the gutter.
3. Milkers are nearer the light.
4. All cows do not go through one door.
5. Narrower barns can be used.

The advantages of facing cows out are as follows:

1. Easier and more economical to clean stables where one can drive through with a manure spreader. Where a driveway can be used there is no rehandling of manure which saves the expense of an overhead litter carrier.
2. Cows can get in and out of a wide door with more safety. It is generally less difficult for cows to find their stanchions when entering the barn at the driveway.
3. Hay chutes can be placed along the side walls of the barn. The opening of the hay chute into the basement is directly in front of the cows. It is easier to put hay in chutes at the side of the barn than in the middle of the mow as the hay is always higher in the middle.
4. There never was a barn built where the cows face the center that was wide enough to prevent the side walls from being spotted with manure.
5. Less total litter alley space is needed.
6. More work is done behind the cows than in front.
7. Milking machine can be operated more easily.
8. Sunlight strikes manger.
9. Cows show to better advantage.

If possible, when building a new barn or rearranging an old one, have the stock all housed in one barn with the cows in one end and horses in the other. There is a big saving both in building costs and in labor in caring for the stock. It was found that where the horses are in the same barn with the cows, the distance traveled per horse per day was reduced 200 ft. and the time saved was 8 min. per horse. This time is worth as much as the total charge to horses for the use of the building. Sixty-four per cent of the farms had the horses in the same barn with the cows or in an adjoining wing. Thirty-six per cent had them in separate barns with an average distance from the cow barn of 189 ft. There was a variation from 14 to 420 ft.

The summary of the advice that I would give to the average dairyman on barn planning would be: Face the cows out with a driveway between them the full length of the barn. Locate the milk house at one end or side of the stable as near the cows as possible. Locate the silo at the side of the feeding alley and use a feed cart. Place the hay chutes at the side of the barn and between each two mows. Have them large enough so that when filled, there is sufficient hay for one day. Construct a ladder in each chute. Locate the granary above the stable with a spout to the basement in the feeding alley. Place the stairway, the forks and shovels near that center of operation where a farmer most often finds himself when he stops to think and plan his work.

In closing, I feel that this paper is far too brief to cover such an important subject when so many dairymen are being called upon to make changes in their building arrangements. The call has come to all engineers who are interested to give the major essentials of barn design most careful thought.

The General-Purpose Motor—Its Requirements and Possibilities[1]

By C. P. Wagner[2]

PERHAPS no other one item concerned with rural electric service is as important as the economics of energy application and the method of application of machinery on the farm to electric drive. We have reached the point where all the belt work on the ordinary farm, except threshing, can be performed with motors as small as 5 hp.

On Minnesota farms, we have found power applications and motor sizes in demand to be about as follows:

1. Water pumping from wells as deep as 200 ft. (We prefer usually to recommend a ½-hp. repulsion induction motor.)

2. Cream separator. (Motor recommended by manufacturer of separator.)

3. Standard electric washing machine. (¼-hp. split-phase motor.)

4. Milking machine. (These machines are now made to require ½ hp. for as high as a 6-cow machine, although some present models will not start easily with less than a 1½-hp. motor, particularly in our cold winters when machines stick badly.)

5. Workshop. (To be equipped with whatever size motor may fit the job.)

6. Ice machines and refrigerators. (To have their own motors.)

For the above-mentioned jobs we prefer to recommend the individual motor drive, motors to be protected with automatic thermal overload devices for all automatically controlled equipment.

Others machines to which we have adapted the electric drive are as follows:

1. **Ensilage Cutter.** (a) To cut ensilage and elevate it into any size silo; (b) to cut hay into lengths up to about 1½ in. and blow it into storage bins; (c) to cut and elevate corn stover; (d) to shred and elevate corn stover, and (e) to use blower without knives in place for elevating grain and feed. The ensilage cutter can be made into a seven-months' machine in our territory, if we use it for all of the things for which it can be made available. With small motors the cheapness of the power is encouraging farmers using electricity to build many more silos and to utilize all of the foodstuffs available on the farm.

2. **Feed Grinder.** The hammer mill for grinding small grains to any fineness. The buhr mill for grinding ear corn and small grains to satisfactory fineness.

3. **Roughage Cutter and Feed Grinder,** a machine which will cut the same products as listed under the ensilage cutter, but which will cut them much finer; some of these types will grind this feed through a standard burr mill.

4. **Irrigation Pumping.** Quite often motors for this job are of the larger sizes comparable with those for grinding feed, filling silos, etc. The job, particularly in our district, is very seasonal as we have sufficient rains except in unusual seasons. More irrigation can be developed if costs can be kept down.

Electric power is often required for the following miscellaneous uses:

Blowers and Ventilators	Hullers
Bone Cutters	Ice Chippers
Bone Grinders	Ice Conveyors
Butter Churners	Ice Cream Freezers
Cider Mills	Ice Hoists
Concrete Mixers	Irrigation Equipment
Concrete Block Machine	Laundry Machines
Corn Huskers	Liquid Manure Pumps
Corn Shellers	Log Saws
Corn Shredders	Milking Machines
Cross and Rip Saws	Manure Grabhook Loaders
Ensilage Cutters	(operated through hay hoist)
Fanning Mills	Oat Crushers
Feed Choppers	Power Drills
Feed Grinders	Repair Shop Machinery
Feed Mixers and Blenders	Rock Crushers
Fertilizer Grinders and Blenders	Lime Stone Pulverizers
Fruit Graders	Root Pulpers and Shredders
Grain and Seed Cleaners	Sausage Grinders
Grain Conveyors	Sprayer Equipment
Grain Elevators	Vegetable Graders
Green Food Cutters	Water Pumps
Grindstones	Straw Cutters
Hay Balers	Viners
Hay Dryers	Wood Saws
Hay Hoisters	Wood Splitters

To advise individual drives on these miscellaneous machines, would require excessive investment by farmers in motor equipment, many pieces of which will be of very seasonal use. Such practice will also cause the distribution engineer to look askance at us when we wish to hold down the size of the transformers installed. To attempt to operate this machinery from a lineshaft will curtail the usage of our motors. There is, therefore, only one solution to the method of driving, and that is through application of the motor so mounted that it can be moved easily from job to job, be easily belted up, and have connection to lines available. Therefore, the demand for the general-purpose motor.

The above-mentioned jobs come under two classes:

1. Lower speed (very small power)
2. Higher speed (higher power)

There is now on the market portable equipment, back-geared, ¼-hp. motor outfit, with shaft operated at about 440 r.p.m., which fulfills the lower power and low speed requirements only in part, and we feel that this equipment, even though it sells at a low price, should be replaced with a

[1]Paper presented at the rural electric session of the 22nd annual meeting of the American Society of Agricultural Engineers, at Washington, D. C., June, 1928.

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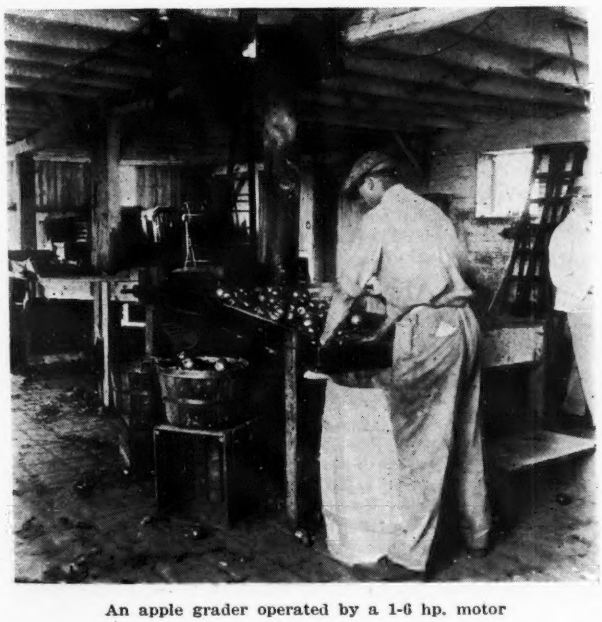


An apple grader operated by a 1-6 hp. motor

½-hp. motor with a more substantial stand. Such a motor can care for the general requirements of Class 1 above mentioned.

General-purpose motors of 3 to 10 hp. are provided for Class 2 jobs. Such motors may be moved from place to place as needed for various jobs. The labor of moving will be very much less than fixed charges against individual drive. For the Class 2 requirements we feel that in every case the utility company should so base their rates and so provide their equipment that the next size portable unit will be 5 hp. or larger.

This is the particular time when we should call attention to the fact that not enough attention has in the past been paid to the diversified requirements of consumers using various sizes of motor equipment; nor has enough attention been paid to the requirements as to loads on line and station peaks. We find in Minnesota that the rural, or other than metropolitan transmission lines, carry their peaks in July and August in early morning, while the station generating peaks occur at about 5:00 p.m. in December. This fact should be given credit when we make our rates.

We believe further in regard to the question of rates that, if the farmer is given single-phase service through one meter and all due consideration is given to proper wiring for one system, we can sell cheaper energy through such a system, provided that we protect ourselves against consolidated loads through the use of one portable unit on the farm, rather than several separate units.

Lineshafts often take more power to operate than would operated machinery. Therefore, our desire is to eliminate them. We recently found a farmer grinding feed by direct drive, but he used the same motor to run a lineshaft on a remotely located milking machine and air pressure pump. We eliminated the lineshaft and located the milking machine and pump at less remote points, with individual drive. This cut the annual consumption from 6800 kw-hr. per year to 3100 kw-hr. Our work effected a considerable rate reduction for this farmer, for after all it is not the price per kilowatt-hour which affects the total cost, but rather the efficiency of operation. We believe all rural service engineers will forget the rate and its application and will apply engineering to show how to get the most work for the least cost. If we do this, then rates will not worry us, nor will the cost worry the farmer. The utility motor will help us in this matter.

Our recommendations for motor sizes on various farms have been classified in order to develop economy for the farmer. These classifications are approximately as follows:

1. For owner-operated farm with one or no farm hands assisting, usually 5 hp.

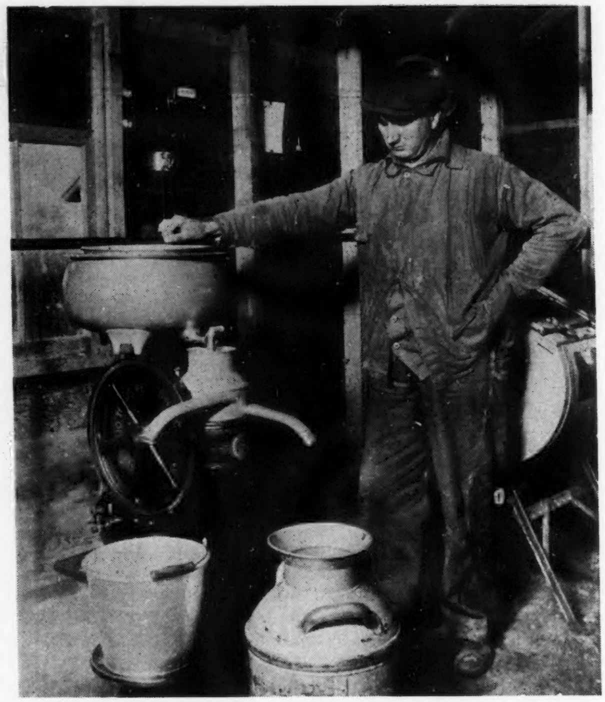
2. For owner-operated farm with several farm hands, and where we do not expect to eliminate them, we recommend unreservedly 7½ hp.

3. For managed estates, owner absent, we unreservedly recommend 7½ hp., and if the farm has several farm hands, we prefer to recommend 10 hp.

These recommendations are based on the expected care and attention which will be given to the operation of the equipment, as well as the capacity requirements. We believe, however, that the future will demand not less than 7½ hp. on most farms of 20 cows or more, and we feel that we must build our fences around that expected demand.

To date not more than one per cent of those farms now connected to our lines are served with three-phase energy, and we have about 2500 farms connected. Our rates are based on one-meter application, giving us low transformer installation costs, and the one wiring system on the farm permits the development of the original installation into a good one of adequate capacity at lowest cost to the farmer, motors up to 10 hp. being allowed on these lines.

We have found satisfactory operation in every case, and therefore believe that the single-phase motor, now manufactured by most companies, will suit this work without changes. We prefer the 1800 r.p.m. motor, because of its low cost and its high efficiency. We also hope that increased production will develop even lower costs on this unit.



Electric motor direct-connected to cream separator in operation on the Red Wing (Minnesota) rural electrification project

The equipment for the utility motor should consist of the following:

1. Truck for 5 and 7½-hp. motor, so wheeled that it can be moved easily in any barnyard by one man; the larger unit of 10 hp. to require not more than two men for long moves and one man for manoeuvering into position.

2. Cable of adequate size and current-carrying capacity to be not less than 40 ft. long and to be equipped with plug for such receptacles as may be installed on the farm from point to point.

3. Proper pulleys, preferably of standard size, for all manufacturers machines. We recommend that diameters be 4½ and 5½ in. for two pulleys to be supplied with each motor. Width of pulleys should not be less than 6 in., as the farmer will not always obtain proper alignment nor will he have available a belt of proper width. Standard pulley diameter will reduce the number of troubles of the farm service man, as he can then advise certain sizes of pulleys for machines to be driven. For instance we have found it advisable to recommend 20-in. pulleys on 8-in. burr mills for 5 hp., using the 5½-in. motor pulley for easy grinding and the 4½-in. for hard grinding. If other sized motor pulleys were used, we would not always be able to give machine pulley diameters offhand.

Nothing less than a 4½-in. pulley should ever be supplied, for loads of 5 hp. or more, as proper belt speeds are of extreme importance.

4. Some manufacturers have placed on the market motors without equipping them with overload devices. Quite frankly we must discourage the purchase of such equipment by the farmer, until such time as the implement dealers are much better supplied with information on motor drive. A farmer who buys such motors will usually hook them to some machine which gives much too great a load, and not knowing the conditions of operating the farmer will continue to overload such motors until a burn-out occurs. We therefore should definitely recommend that thermal overload units be installed on each and every motor sold in our territory. Particularly this will be a protection to the manufacturer and his product, as naturally

the farmer of the future is going to buy that which renders service over the longest period.

5. The utility motor must be protected in such manner as to prevent loss of the oil in the bearings, and in view of the fact that waste-packed bearings are just as expensive as the ball bearing, most of the manufacturing companies are equipping their utility motors with ball bearings. The added expense is nominal and we believe this advisable in most cases.

6. The enclosed self-ventilating type of motor undoubtedly is the best in regard to investment by the farmer, but these are in the early stages of development and prices have not generally been reduced to the lowest stages. Undoubtedly in the near future we can recommend them generously. Dust and dirt of various degrees are very undesirable in the windings of a motor and particularly in some of the makes of centrifugal short-circuiting devices. Some motors have their short-circuiting devices in close-fitting wells within the armature, and these fail to function properly in a short time, if dirt and dust collect freely.

Some engineers have attempted to teach the farmer to mount his motor on skids in order to save money. We believe this to be a wrong practice, as it encourages the farmer to build makeshift starting apparatus, and makeshift cords, both of which are sure to cause trouble for the power company in the not distant future. The savings are not nearly as great as they appear. One manufacturer now quotes the equipment less truck, with an allowance of only $22 for the truck, and certainly the farmer will find the truck worth the $22 paid for it. Other manufacturers are now arranging to provide similar allowances for the truck. In other words, these manufacturers have found that trucks can be made for less money than originally thought.

Our wiring rules provide for motor service receptacles on poles or on the side of a house, with no switch or fuse when motor is equipped with overload device and under-voltage cutout. This materially reduces the wiring costs and complies with safety code practices; but when the motor does not have the overload and no-voltage device, a separate switch and fuse is required.

The utility motor can be made into a good load builder and the farmer can be interested in purchasing them in large numbers, when we show him the large amount of work which can be performed through their use on the farm. The electric rates can be maintained lower for the use of such motors than for individual drive for larger equipment. Standard pulleys to be supplied with each motor will assist in standardizing the pulley size on driven machinery, this last being the largest problem of the future to affect sales. Such motors have lowest original cost compared with the uses available. From all appearances we can give the farmer more for his money and maintain a greater net profit for ourselves through providing the method of application for utility motors. After all, our whole aim is to sell to the farmer energy and service at a lower cost and to increase the utility's gross earnings over that of the past.

Agricultural Engineering in Europe[1]

By Dr. Hermann Schildknecht[2]

AGRICULTURAL engineering on the European continent is a very complex field, and it is not at all easy to show in a short survey its many sided problems. According to the varying agriculture which differs greatly with the ruling customs of farm living in the numerous localities, the questions brought before the agricultural engineer differ considerably. It is simply impossible to compare the agricultural engineering problems of a mountain farmer in the Alps with those of a farmer of the Po Valley in Italy, even though these places are only a few miles apart. For a more or less careful investigation of European agricultural engineering conditions a detailed study of several very different areas would be necessary.

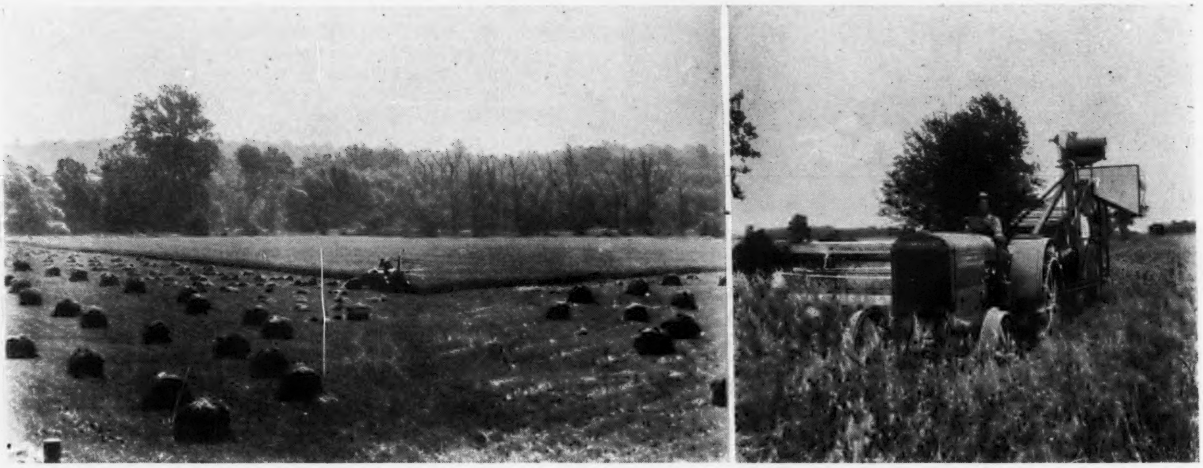
At the present time almost all European countries are making great effort to increase the area devoted to farming and to improve existing farming conditions. Similar to the United States, although the development is slower, Europe is actively working toward the mechanizing of the farm by the use of farm machinery. There are, however, certain conditions which make it almost impossible to change quickly to machine operation. One of the most important of these is the fact that the average farm property in Europe is cut into very small pieces. The application of farm machinery is economic only on larger tracts. In Europe the majority of farmers live in villages at a greater or less distance from their farms. In the earlier days, if a farmer died, it was more or less the custom to subdivide his property according to the number of his children. As a result of this practice the land became in time scattered in small units. It is hardly possible to farm with profit if the land is divided into four to fifteen plots, at varying distances from the village, as is often the case. Under such circumstances a farmer spends a great part of his time on the road and is not able to do effective work. An investigation in the Canton Tessin in Switzerland where the farmers used to have many children showed that the average area of the plots was only 1300 sq. ft. Some years ago an electric power line was built through one of these districts. To get the necessary land for the construction of the foundation of one tower, land of eight different farmers had to be appropriated.

Along with these unfavorable property conditions, many other disadvantages are interconnected, which make farming difficult and hardly attractive. The lots are not only small in area but are at the same time of most unusual shape. Because of the fact that there are no existing farm roads, the farmers are compelled to cross the property of others in order to reach their own land. Such rights to pass do enormous damage to the crops and do not help to establsh friendly relations between the different families in a village. That these boundaries are difficult to keep up and often create divergence in opinion is evident.

These conditions can only be overcome by a fundamental change in the property holdings. This work is at present an important field for the European agricultural engineers. All old property lines are being abolished and a completely new arrangement of property holdings established. To make this possible, laws have been passed which allow a majority of the property owners to compel the others to join in the movement. As a first step in this reparcelling the old property is surveyed estimated, and the share of each farmer determined. The estimation itself is done by a special official committee, according to skillful scientific methods which treat all impartially. Land needing any kind of reclamation is brought up to its full producing value, so that only good land will be distributed later. Streams are regulated, canals built, and underdrainage systems established, or the land fitted for irrigation. At the same time a network of roads is built, so that as a rule every piece of property may be reached by two roads.

In reparcelling the land it is intended that each farmer shall receive the same value in land and at the same time approximately the same surface area. In order to diminish the number of lots an effort is always made to buy up the very small tracts. Then it is naturally attempted to give each farmer a single parcel only in the redistribution. This ideal is very difficult to attain. Such work is very effective and makes farming more profitable by permitting the use of machinery. The best possible proof of the necessity for these property changes is the fact that farmers in such re-

[1]An address before the 22nd annual meeting of the American Society of Agricultural Engineers, at Washington, D. C., June, 1928.
[2]Agricultural engineer, Republic of Switzerland.



From an artistic point of view the scene at the left is beautiful, but from a practical dollars-and-cents standpoint the one at the right is more attractive to the farm manager. The tractor-operated binder was a big advance, but the tractor and "combine," as an engineering achievement, is a much bigger step in the direction of a truly engineered agriculture

parcelled areas never wish to return to the old conditions after they have tried out their new farms for a couple of years. Naturally the new laws restrict the subdivision of farms in order to prevent the cutting up of the newly established larger tracts.

In connection with the aforementioned property improvements, efforts have been made to create new settlements. If the farmers live in villages, even a property of some size which is far away from the home of the farmer can not be farmed easily. This same thing is found with big reclamation areas where no houses exist. As long as the land is not settled the reclamation is not made effective. Therefore, in Europe, new settlements are established between villages and in large reclaimed areas. These settlements are designed to be model farms, and embody the most up-to-date technical features. Due to the effectively concentrated property holdings farm machinery can be used to a large extent. These settlements in Europe are built in most cases by government aid and mainly from the standpoint of internal policy are considered to be of public interest. To avoid any speculation with such buildings, limitations are established governing their sale.

From the reclamation standpoint drainage plays the most important role in Europe. Large areas of this continent are swamp land and many marshes are found along the different coasts. Drainage is accomplished in most cases by tile. The average high price of land does not permit the use of open ditches except perhaps in peat land. In Europe the tile lines are laid much closer and also much deeper than in America. The drain distances which are common for loam and clay range according to climate and farming conditions between 20 and 60 ft., with an average depth of 4 to 5 ft. Only in sandy soils of alluvial character are drains spaced as wide as 100 ft. Practice has shown that with drains spaced too far apart insufficient drainage results, which is really the case with many drainage areas of the United States. Poor drainage is worse than no drainage at all because large sums in labor, seed, and fertilizers are wasted. Due to the fact that a tile drainage system has a long life, the European agricultural engineer has the opinion that higher costs for sufficient drainage pay well in the long run.

Contrary to United States practice, in Europe the connection of surface drainage with underdrainage systems by the use of surface inlets is carefully avoided. Most systems where surface inlets are used have been put out of commission by clogging in a relatively short time. There is at present in Europe a movement away from the so-called systematic drainage, that is, systems of parallel drains with more or less constant spacing. It has been shown that in alluvial valleys the ground water sometimes flows along channels which can be drained with a few tile lines. The aim in this so-called channel drainage is to find these underground water courses with the divining-rod and to lead them away with tiles. This method, although not fully dependable, has given many good results.

Another drainage practice which is extending rapidly is mole drainage. Introduced from England where it was used in the last century it has now been adopted in Holland, Germany, and some eastern countries of the European continent. Mole drainage is not so much used for real ground water drainage to lower a high ground water level in the soil as for the purpose of coagulation or air drainage to improve the structure of dense, heavy soils and make them thus more suitable for plant growth. For this purpose, in Bohemia for instance, tile drainage has been established with great success in soils which never were too wet. The structure improvement was evidenced by an increased yield of sugar beets. The construction of mole plows in Europe has been improved greatly in recent years. Because mole drainage is much cheaper than tile drainage it seems to have a great future in Europe.

Pumping plants for drainage are very common in Europe. In many valleys the streams are higher than the surrounding land and the drainage of these areas is possible only by artificial lifting of the water. Extensive areas of marsh lands have been reclaimed. By leveeing along the coast, large areas previously covered by water are now splendid farm lands, as will be the case with the Zuider Zee improvement in Holland.

Irrigation in the dry areas follows much the same lines as in the United States. The methods of applying water are mainly furrow and border irrigation. In addition to this a very interesting irrigation practice along new lines has developed, namely, overhead sprinkling. In many European countries water for irrigation purposes has become very scarce. The water of the streams is held under old navigation rights and when an increase in irrigation was desired only small quantities of water were available in spite of the fact that it has been proved that water is more valuable for agriculture than for navigation. For this reason the irrigation engineer was confronted with the problem of irrigating the largest possible area of land with the least water. That the usual furrow and border method could not be considered is clear without further explanation. Especially in more sandy soils a large percentage of the irrigation water percolates into the deeper layers of the soil. A radical development of spray irrigation resulted and the European plants for overhead sprinkling are very different from those obtainable in the American market. Permanent systems can not be built economically for the average demand in agriculture because the cost per acre is too great. Therefore, in Europe permanent spray plants are installed only in truck gardens. The plants for the larger areas are so constructed that with a minimum cost for equipment a large surface can be irrigated by a system of rotation. By ingenious couplings which allow

connections to be made quickly, the pipe lines can be moved easily and with a small loss of time. To keep the friction loss and pumping costs as small as possible, pipes from 2 to 8 in. in diameter are used. Since the pipe units for so-called "rain wings," which are the final distribution pipes, have to be moved frequently they are made out of strong light-weight metal. Special stationary or revolving nozzles, which work under a pressure of from 20 to 50 lb., cover a given area with a considerable quantity of water in a short time without seriously clogging the soil. The quantity can be so regulated that it will all be retained within the root zone, thus avoiding percolation loss. The crop increase with overhead sprinkling has been found to be considerably greater in Europe than with any other irrigation method. Since the movable spray equipment costs only about one-half as much per acre as a permanent one, irrigation by overhead sprinkling has been found to be economical, not only in the dry but also in the semi-humid section. It is used extensively in the northern and eastern parts of Germany, Austria, Czechoslovakia, and Hungary. To determine the limits of economical irrigation, so-called drought maps have been made which show the probable number of months when the rainfall is not sufficient for successful farming.

Many other agricultural engineering problems will probably be solved by means of spray irrigation. The sewage disposal of small villages and towns in agricultural areas needs very costly structures. As a result of this there is at present an active movement toward the utilization by spray irrigation of this sewage which is valuable as fertilizer. Already a few such plants have been constructed and results are very promising. Spray irrigation of sewage does not possess any of the disadvantages of the old method of broad irrigation. Even industrial sewage is used in this way for agriculture. Overhead sprinkling may bring a change in the method of distributing fertilizers because small quantities may thus be uniformly distributed over the fields. Washing of the salts out of the root zone is therefore not possible. Furthermore, chemical sprays for controlling plant diseases may be easily distributed by such equipment. An interesting feature of the European overhead spray equipment is that it is also designed for fire fighting. With such an outfit a pipe line capable of carrying a considerable quantity of water under high pressure from the nearest possible pump location to the fire can be quickly set up.

Very interesting are the agricultural engineering problems in the Alps. In the mountain valleys of France, Italy, Switzerland and Austria there lives a rural population which farms under very unfavorable conditions. They have some cattle and plant some grain, potatoes and other vegetables for their own use, but their principal business is dairying. Milk, butter, and cheese production furnishes their income. Because these mountain valleys are relatively inaccessible the transportation of the products is not easy. In addition to this the dwellings of these mountain farmers are very primitive. Therefore, it is not surprising that in this day of a higher standard of living many have left their places and sought better ones. Whole valleys have thus been nearly depopulated. Many farmers moved to town or emigrated to foreign countries, including the United States. The governments tried hard to prevent this, and subsidies were given to keep the farmers on their farms. Agricultural engineering works have proved the greatest aid in doing this. The mountain valleys have been opened by modern roads, and in many cases cableways have been constructed to facilitate the transportation of milk and other dairy products. Mountain pastures are cleared of brush and weeds and the many stones removed. Wet places are drained by open ditches or tile lines. If necessary, inexpensive irrigation systems are constructed. For the people better houses are erected and stables for their cattle; also buildings for butter and cheese manufacturing. The European agricultural engineer has here done a useful and important work, and the mountain farmers for the most part now remain on their farms.

In nearly all European countries the agricultural engineering is done by the governments. Private enterprises are not so frequent. The projects are designed by the official bureaus which have supervision of the project during and after construction.

Educational institutions for agricultural engineering are numerous in Europe. In fact, most agricultural colleges have a school for agricultural engineers. The most important difference between European and American institutions is that farm machinery is not considered to come under agricultural but under mechanical engineering.

Research work in agricultural engineering is not yet so well organized as in the United States. Most of the investigations are made by the professors in the agricultural engineering colleges. Scientific service for the practice is very poor in many countries.

Reclamation is considered in Europe as a question of public interest. All European countries import large quantities of agricultural products a part of which they might grow themselves. Besides that a steady drift of workers from agriculture to industry can be observed. This only serves to make the question of unemployment more serious, and to be a real menace to the countries concerned. For this reason different governments are striving to keep the agricultural population at least at its present size. This is attempted by subsidy, mainly in agricultural engineering, by which means the productive farming area is increased and new settlements established. The smaller neutral countries in Europe learned by experience during the World War that it is valuable for the whole population to have every spot reclaimed. For instance, during the war Switzerland was cut off from the world and would have starved had it not since 1893 been steadily increasing the farming area by a wise reclamation policy.

The whole history of European reclamation clearly proves that, without government aid, reclamation does not take place even when it is needed. Effort was always made to interest private capital in reclamation but these attempts have nearly always failed. The reason for this is not that reclamation has been found to be uneconomical. If in a country more land is needed for agriculture, reclamation always pays. This has been proved in Europe by many careful investigations. To obtain private money for reclamation the farmers had to pay high interest. Besides that the money could be obtained for a few years only. This led to a very unsound policy. In reclamation works a long time investment is absolutely necessary. In addition to that only small profits can be obtained in the first years. If interest rates were high and the farmers had to pay back the money too soon, they went bankrupt. This often happened in Europe and tended only to make it more nearly impossible to get money from private sources. In reclamation no speculation is possible if the work is to be established upon a sound basis. Therefore, in Europe the capitalists prefer to invest their money in industry where they have the possibility of receiving large returns within a short period. Another reason why reclamation is an unfavorable means for speculation is the fact that such works may furnish the whole population with advantages which ought to be paid by the governments. Very often in Europe the drainage of whole valleys has been undertaken, not only to improve the land agriculturally but also from the hygienic standpoint, as the previous conditions had been the cause of constant diseases among the populace. From such improvements nobody can make a profit in money.

Because no reclamation work was being done, although badly needed, the different governments were compelled to support and finance agricultural engineering works themselves. This is done in different ways. The governments make long time loans at low interest rate, although this practice meets objection from the banking institutions. In other cases to avoid that objection the countries pay a part of the interest on private money and guarantee the loans. In other cases a large part of the construction cost is simply paid by the government so that the farmers in Switzerland, for example, may pay as little as 15 per cent of the costs.

This policy of the European governments has helped agriculture to a considerable extent and as a result valuable agricultural engineering works have been built which the different nations view with pride. Public opinion considers that this public money has been wisely expended and favors the continuation of the policy.

Research in Farm Machinery — 1927[1]

By R. W. Trullinger[2]

RESEARCH work in farm power and machinery appears to have undergone considerable reorganization largely for the better during 1927, probably as a result of the activities of the Advisory Council on Research in Mechanical Farm Equipment, comprised of representatives of the U. S. Department of Agriculture, the American Society of Agricultural Engineers and the National Association of Farm Equipment Manufacturers. This was especially true at the agricultural experiment stations, where there was an evident tendency to close out general and indefinite work and to substitute sound productive work for it so far as possible. This building for the future naturally tended to cut down the amount of results reported during the year somewhat. A complete review of all of the work reported cannot be made here. Attention will be drawn only to the more outstanding results reported.

TRACTORS

Very few results indicating definite improvements in the ability of the tractor to satisfactorily meet certain severe requirements of agricultural operations were reported. The Alabama station continued the study of traction and again showed that the resistance to shear determines the tractive value of a soil and that the greatest factor in the transmission of impulsive force from any lug depends upon the tractor taking the fullest advantage of the arch action of the soil. It was also verified, under field conditions, that the highest efficiency is produced with a weight on the tractor wheel just sufficient to force the lug into the soil, and that the output increases with the width of the wheel rim under these circumstances.

The California station, in continuing the study of air cleaners, developed a special method of testing air cleaners of the radiator fan type. By this means it was found that the air cleaners of this type tested were, with one exception, of rather low efficiency. The vacuum or restriction effects were found to be low and were unaffected by accumulation of dust except in two cases.

These studies are typical of the sort of work which appears to be needed on tractors. Agricultural operations involving draft offer so many unusually severe conditions and requirements in different localities that the necessity for the specific development of tractor features to meet them seems quite evident. The identification of important specific deficiencies in tractors on this basis and the concentration of efforts on their correction appears to be a profitable undertaking at this time. The changes and improvements in tractor details indicated by the Nebraska tractor tests suggest that this is being done to a certain extent by some agencies.

INTERNAL-COMBUSTION ENGINE FUELS

Considerable work was done by different agencies during the year on fuels for internal-combustion engines used especially in automotive machinery.

The engineering experiment station of the University of Illinois reported that the efficiency of an engine increases with the compression ratio and with the amount of air used for the same compression. The power is a maximum when the air supply is somewhat less than 100 per cent of the theoretical amount. Thus the mixture for maximum power is a mixture of relatively low efficiency. The ideal efficiencies obtained from various liquid fuels were practically the same.

In engine acceleration studies the U. S. Bureau of Standards showed that the most important and pronounced lag in acceleration always occurs during the time the engine speed is increasing from 250 to 350 or 450 r.p.m., and that different carburetors may give marked differences in performance at normal temperatures. The plain tube type carburetor gave the best performance and the most consistent results. The acceleration obtained under a given set of conditions was found to be largely dependent upon the temperature of the intake manifold.

In studies of the characteristics of some anti-knock fuels, the Texas engineering experiment station found that while the use of such fuels will permit changes in engine design resulting in increased economy, there is little or nothing gained aside from the smoother performance of the engine when the price of these materials is considered.

Studies by a private institution indicated that acids are always present in crankcases, some of which are corrosive. The use of gasoline containing 0.04 per cent of sulfur caused no corrosion of wrist pins and other moving parts, but when using a gasoline containing 0.151 per cent of sulfur, the corrosion was very appreciable and the water in the crankcase contained free sulfuric acid. When using a gasoline containing 0.458 per cent of sulfur the corrosion was very serious.

It is to be noted that the above studies of fuels were for the most part not conducted by agricultural engineers. Attention is drawn to them, however, on account of their evident bearing on tractor and stationary engine operation. It seems likely that agricultural engineers should know more about the requirements of fuels for the most satisfactory performance of certain agricultural operations by tractors and engines. It does not seem adequate to merely specify gasoline or kerosene when economy in fuel and lubricant consumption, in engine or tractor depreciation, and in time consumed in operation, are so important in agricultural production.

TILLAGE MACHINERY

Very little work on tillage machinery was reported during the year. The Nebraska experiment station showed that the draft of a plow is not affected by the increased moisture content of the soil at low values, but was increased very rapidly with one soil after 50 per cent of the moisture content was reached.

In plow draft tests under several soil conditions, the Arkansas experiment station found very little difference in the draft per square inch within the range of cut of from 10 to 30 in. in width. With one exception the draft was heaviest in cotton stubble and lowest in soybean soil. Cowpea stubble and sod were intermediate.

The results of comparative tests at the California experiment station of the wearing qualities of pearlitic manganese steel harrow disks, heat treated to four different degrees of hardness, and ordinary openhearth carbon steel disks not heat treated, showed that considerable edge deformation occurred in the common crucible steel on a gravel road and a little in the softest of the pearlitic manganese disks. The hardest disks maintained a sharp cutting edge throughout the tests.

The results of draft tests of tillage machinery in different soils appear to serve mainly to indicate that much is yet to be learned regarding the important features of such machines, particularly those which come into frictional or other contact with the soil. It seems likely that the work with the metals entering into such parts should go a long way in solving some of the important tillage and tillage machinery problems.

HARVESTING MACHINERY

Combines. Considerable work was reported during the year with combines which, for the most part, however, appeared to be mainly farm management in nature. Such work was reported by the U. S. Department of Agriculture and by several of the agricultural experiment stations in the grain-growing sections and was apparently led in most cases by farm management departments. There was agri-

[1]Report presented at the Power and Machinery Session of the 22nd annual meeting of the American Society of Agricultural Engineers at Washington, D. C., June, 1928.

[2]Assistant in Experiment Station Administration (Agricultural Engineer), Office of Experiment Stations, U. S. Department of Agriculture. Mem. A.S.A.E.

The Peak Load of Agriculture

THE operation of plowing is frequently referred to as the "peak load" of agriculture. It does in fact consume more power annually in this country than do all the factories put together. But it was not until the internal-combustion-engined tractor had been developed to the point where it was practical and economical that there was available to agriculture a source of power adequate to meet all plowing and other power needs. The tractor is indeed one of the greatest contributions of engineering to agriculture. It has increased tremendously the capacity of the individual operator, and reduced in like manner the time hazard. The tractor is to agriculture what the locomotive is to the railroads.

cultural engineering cooperation in the majority of instances, apparently to insure accuracy in the adjustment and operation of the machinery used.

In addition to their contribution to farm management knowledge, it seems likely that such studies can serve a very useful purpose by indicating to agricultural engineers the important specific deficiencies in available combine machinery, on the correction of which much of their attention may possibly be profitably concentrated.

It seems advisable, therefore, that agricultural engineers distinguish between advisory participation in farm management studies of combines, which of necessity consider a large number of factors, and specific engineering undertakings to correct or improve individual deficiencies in combines or combining operations as they become evident, which can usually best be limited to a consideration of one or two factors at a time. Such work is exemplified by the efforts at the California experiment station to develop the bulk handling of grain, and those at the Illinois station on low cutting and the reduction in cylinder speed in soybean harvesting.

Threshers. In Germany work has been in progress on the shaker feature of threshers resulting in the development of simple, economical, and efficient vibrating shakers. Blowing stackers have also come under investigation in Germany, resulting, for example, in the finding that the best proportion of air and straw in the blow pipe is 1 kg. of straw to 3 cu. m. of air, at a velocity of 20 m. per sec.

CROP DRYING EQUIPMENT

Important developments seem to have taken place during the year in the artificial drying and curing of crops. A continuation of the corn drying studies at the Illinois experiment station indicated no advantage in using temperatures of more than 150 deg. F. From checks made on the germination of corn, it appeared best to keep the drying temperatures for seed corn 10 deg. or more below 125 deg. for best results. When the grain was dried to 12.5 per cent or less of moisture, the cobs were found to contain less moisture than the grain, indicating that the materials in the grain exert more pull on the moisture than do the materials in the cob.

The California experiment station found 160 deg. F. to be approximately the highest safe temperature for the dehydration of carrots and peas, while for cabbage the temperature should not exceed 150 deg. While higher temperatures increased the rates of drying, they apparently resulted in injury to the products. Air velocities in excess of 500 ft. per min. were found to slightly increase the rates of drying but showed a tendency to injure the quality of the products. An air flow of 500 ft. per min. at a temperature of 160 deg. gave the most economical use of heat.

Studies such as the above appear to be fundamentally sound and provide the bases for laying down specifications for necessary equipment. Such work is growing in importance in the agricultural industry and probably should be given consideration in the organization of many research programs.

FEED GRINDING MACHINERY

A few results from feed grinding experiments were reported during the year.

The hammer mill studies at the Wisconsin experiment station indicated that the capacity of the mill increased as the speed decreased and the product became coarser. The fineness varied in inverse proportion to the rate of feeding and was reflected in every horsepower change. This was taken to indicate that for each set of conditions there is a critical point in the quantity fed a hammer mill at which the mill is most efficient and at which a heavier or lighter feed results in either a coarser product or fewer pounds per horsepower-hour or both. Apparently the initial impact of the hammers against the feed does not do the grinding. Removing the screen produced a hulled and cracked grain product. The use of a fan appeared to result in a coarser feed. The more nearly solid the cross line of the hammer rows is, the better are the results. There was no advantage in staggering hammers. It was shown quite conclusively that all of the grinding is done by the extreme tips of the hammers plowing through a fluffy, whirling layer of material between the periphery of the hammers and the housing. All of the experiments indicated that with the cereals the rubbing action is by far the most important and that the explosion due to initial impact is negligible. With corn and other heavy and brittle materials impact is probably of greater importance. The choice between swing or rigid hammers can apparently be made without regard to grinding effect.

The Oregon station found that for fine grinding the hammer mill gives better results than the burr or roller mills. The temperature increase in ground grains varied from 4 to 58 deg. F., almost directly with the power used per 100 lb. ground. Practically the same temperature changes took place when using the roller mills as when using burrs. Tests of coarse, fine, and crowfoot burrs showed that the fine burrs gave greater capacity in the stover mill for the same degree of fineness than the crowfoot burrs and required considerably less power. In general, the throat opening was found to

have a greater influence on the fineness of grinding than any other factor. At the same moisture content and for all mill types, oats showed the greatest power requirement per unit ground, followed in order by barley, wheat, and corn.

The comparative testing of available makes of feed grinders is evidently giving way to studies of the requirements of ground feed for certain purposes, and efforts to develop the mechanical principles of grinders which will produce it. It is interesting to note in this connection that feed grinding tests have been conducted at the Indiana experiment station in connection with feeding tests of dairy cattle. It is thus made possible to carry on the feed grinding development work with a very definite object in view.

MISCELLANEOUS MECHANICAL EQUIPMENT

A few results of work on miscellaneous mechanical equipment were reported during the year.

Corn Planters. The Illinois experiment station found that dust treatments of seed corn apparently do not aggravate the natural wear of the planting mechanism of corn planters but rather have a lubricating effect. However, they do decrease the accuracy of drop.

Orchard Heaters. In laboratory studies of orchard heaters the California experiment station found the burning rate to be important since it governs the rate of heat production. Changes in wind velocity, air temperature, and temperature and volatibility of the fuel altered the burning rate. Too high a burning rate was found undesirable since it tends to increase smoke and losses by radiation and by gases rising too high. Frequent and careful regulation was also found desirable. High upward velocities and high temperatures tended to waste fuel. Smoke was found to be of little or no benefit as a blanket to prevent radiation. Oil fuels were more effective than solid fuels.

Windmills. Analytical studies conducted at the University of Gottingen in Germany on the windmill indicated the special importance of the wind wheel sail, and showed that the power output of a wind wheel of a given diameter is not increased by an increase of the sail surface so much as by an increase in the total diameter of the wheel. The sail area must be smaller the greater the speed of revolution of the wind wheel. The most desirable speeds are limited by the rapidly increasing energy losses with increasing speed.

Mechanical Grain Treatment. The German Society of Engineers reported that the problem of continuous treatment of grains with fungicides by mechanical means is not yet completely solved. The continuous mixing of grain and dry dusts does not present the difficulty that the continuous addition of the two materials to the mixer does. When the fine dry dust is added through the same tubes as the grain, the entrance of the grain is considerably retarded. Further study is being concentrated on this feature.

MACHINERY MATERIALS

Very little work has been reported by agricultural engineers on the materials of construction of farm machinery. However, some agencies have been doing work which should be of interest in this connection.

The engineering experiment station of the University of Illinois reported studies on the fatigue strength of cast iron as a material of construction. Endurance ratios were found to vary from 0.33 to 0.46 with an average value of 0.35. Specimens from a large cylinder casting showed lower values for both ultimate tensile strength and endurance limit than did specimens from castings in the shape of pipes. The endurance limit of the latter was increased about 30 per cent and of the former about 40 per cent by the application of a large number of cycles of stress slightly below the original endurance limit. This is taken to indicate that cast iron develops some intracrystalline slip with consequent favorable readjustment of stress distribution without starting a fatigue crack. The effect of holes and grooves in reducing the fatigue strength of specimens from castings in the shape of pipes was found to be less than these effects in steel specimens. Tests at high temperatures of specimens from pipe-shaped castings gave little indication of reduction of either ultimate tensile strength or of fatigue strength up to 800 deg. F., and the proportional diminution of fatigue strength under higher temperatures was found to be slightly less than the proportional diminution of ultimate tensile strength and of Brinell hardness. Tests of the fatigue strength of these specimens under cycles of flexural stress varying from zero to a maximum in tension showed the endurance limit to be 48 per cent above the endurance limit for cycles of completely reversed stress. Tests of the fatigue strength under cycles of axial stress varying from zero to a maximum in compression, showed the endurance limit to be 59 per cent of the ultimate compressive strength.

A private institution reported studies indicating that the hardness or chemical composition of cast iron are by themselves no indication of the wearing properties of the iron. Irons containing a large amount of free ferrite were found to wear rapidly, whereas others having considerable pearlite or sorbite in their structure showed good wearing properties. The presence in cylinder blocks of excess carbide spots or of phosphides of high phosphorous content is deleterious because such spots wear in relief and the material ultimately breaks out acting as an abrasive. The addition of nickel or nickel and chromium to the iron was suggested as a means of obtaining the correct microstructure for a combination of good wearing qualities and machinability.

The Massachusetts Institute of Technology showed that a very thick film of rust is required to decrease appreciably the corrosion rate of copper-bearing steels, and that the more easily corroded steels have a much longer life when protected by even a thin film of corrosion product. In cases of metals such as cast iron a thick film of rust may be allowed to build up and corrosion be practically stopped.

The Society of Engineers of Germany has inaugurated a study of gray and black cast irons and semi-steel, plain and heat treated, with particular reference to its use in harvesting machinery. Certain points relating to the value of heat treating cast metals for this use have already been established.

The above results suggest, therefore, that a consideration of the requirements for metals used in the construction of farm machinery may be a profitable undertaking with reference both to strength and friction parts.

CONCLUSION

It seems quite evident that the activities of the Advisory Council on Research in Mechanical Equipment have stimulated the organization of more sound and productive work in farm machinery. While the total output of results was perhaps smaller during the year than usual, it appears that the general character of the work is of higher quality than ever before. There is every evidence that the work in the subject is being strengthened.

The need for more work in the subject may be reflected in the fact that, according to the U. S. Census Bureau, the total value of farm equipment manufactured in 1925, showed an increase of 21.4 per cent over the production during the previous year. The increases occurred in nine out of eleven groups of mechanical equipment, the exceptions being harvesting and haying machinery. This indicates that the demand for labor-saving machinery is increasing rapidly and that the responsibility of agricultural engineers that the right machinery be produced and that it be properly used is increasing in like measure.

Carbide Lighting

BECAUSE he liked so well the quality of the carbide light, as well as its other advantages, and because the original carbide gas generator that had been in continuous service in his home for twenty-five years needed replacing, Rear Admiral N. R. Usher of South Carolina has had another generator installed in its place.

The residue from these carbide gas plants is an exceptionally high grade of hydrated lime that can be put to profitable use. One owner recently used it for whitewashing the main trunks of trees in an entire orchard.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

A Study of the Colloidal Fraction of Certain Soils Having Restricted Drainage, W. L. Powers (Soil Science, 23 (1927), No. 6, pp. 487-491, figs. 2).—In this percolation study from the Oregon Experiment Station, the increase in rate of percolation through Dayton silty clay loam soil and a heavy alkaline loam from the Vale experiment field indicated that all treatments were better than no treatment at all, but that the greatest success was obtained with treatments of lime and manure, sulfur and manure, green manuring and the use of alum and a saturated solution of calcium sulfate. Qualitative flocculation studies on the colloids of these soils gave the usual indications with respect to the relative activity of mono and polyvalent ions. Titration curves, very similar for the colloids of all the four soils studied, are also reported, together with cataphoresis experiments, in which at from pH 10.0 to 2.5 the colloids all indicated a negative charge. Lysimeter studies indicated that in all cases lime and manure applications, singly or in combination, increased the percolation, and field trials showed that 1 ton of sulfur or 4 or 5 tons of gypsum used with a light application of manure were effective for structure improvement in sodium saturated black alkali land.

Architecture and Home Organization ([London]: Association Teachers of Domestic Subjects, 1926, pp. [1] + 40, figs. 5).—Practical information on the subject is given.

The Design of the Kansas Home, H. E. Wichers (Kansas Engineering Experiment Station Bulletin 19 (1927), pp. 84, figs. 62).—Practical information is given on the design of homes particularly adapted to Kansas conditions.

Cameron Hydraulic Data (New York: Ingersoll-Rand Co., 1926, 6. ed., pp. [8] + 69 + [17], figs. 28).—This is the sixth edition of this book of hydraulic engineering data.

Electro-Farming, R. B. Matthews (Scotland Journal of Agriculture, 10 (1927), No. 3, pp. 271-279).—A review of the present status of the use of electricity in British agriculture is presented.

Engineering in Agriculture, Raymond Olney (Engineering News-Record, 100 (1928), No. 2, pp. 58-62, figs. 5).—A sketch is given of the agricultural revolution brought about by farm machinery and the present transformation which power is bringing about, together with a forecast of problems to be solved by agricultural engineers in the future.

Handbook of Mechanical Refrigeration, H. J. MacIntire (New York: John Wiley & Sons; London: Chapman & Hall, 1928, pp. VII + 724, pls. 22, figs. 376).—This is a handbook of information on the subject covering both design and operation of refrigerating systems. It contains chapters on the compressor, the absorption refrigerating machine, fittings and condensers, the automatic refrigerating machine, heat transfer, refrigerants, brine and brine systems, the water supply, erection and operation, the testing of refrigerating plants, piping, ice making, cold storage, the cooling and conditioning of air, miscellaneous applications of refrigeration, hotel and apartment refrigeration, refrigeration in the chemical industry, safety devices and fire protection, costs of refrigerating machinery and equipment, specifications, electric motors and steam and oil engines.

Windmills in the Light of Recent Investigations [trans. title], A. Betz (Naturwissenschaften, 15 (1927), No. 46, pp. 905-914, figs. 9).—Analytical studies conducted at the University of Gottingen of the windmill as a source of power are reported.

The results indicate the special importance of the wind wheel sail, and that the power output of a wind wheel of a given diameter is not increased by an increase of the sail surface so much as by an increase in the total diameter of the wheel. The most favorable value of the sail surface is given, and it is shown that the sail area must be smaller the greater the speed of revolution of the wind wheel. The most desirable speeds are limited by the rapidly increasing energy losses with increasing speed.

Volatility Data from Gasoline Distillation Curves, O. C. Bridgeman (S.A.E. [Society of Automotive Engineers Journal], 22 (1928), No. 4, pp. 437-448, figs. 6).—In a contribution from the U. S. Bureau of Standards an analysis is presented of data from a variety of gasolines which appear to indicate a definite relationship between the results on volatility and those obtained by the standard distillation method of the American Society for Testing Materials. It is thus apparently possible to deduce from the latter, with reasonable accuracy, the information on volatility which is pertinent to satisfactory engine performance. It is also pointed out that volatility can be regarded as the tendency to escape into the vapor or gaseous state, and this tendency is determined by factors which must be precisely specified so that numerical values for volatility may have significance. It is concluded that the A.S.T.M. distillation curves give a true indication of the relative volatilities of gasolines.

Previous Investigations on the Plowing Resistance of Soils and a New Implement for Its Measurement [trans. title], Marks (Technik Landw., 7 (1926), Nos. 11, pp. 232-235; 12, pp. 255-266, figs. 14; abs. in Biedermann's Zentbl., 57 (1928), No. 2, pp. 86, 87).—A review of work by others bearing on the subject is presented, and a new apparatus for the measurement of the resistance of soils to plowing is described. Some results from the use of this apparatus are presented graphically and discussed.

Testing Set-Up Experiments on Fertilizer Distributors, W. Mertens (Technik Landw., 8 (1927), No. 2, pp. 28-31, figs. 11).—A description is given of a new testing stand for fertilizer distributors, and some test results with different feretilizers are reported and discussed.

Characteristics of Some Anti-Knock Fuels in Internal Combustion Engines, M. K. Thornton, Jr., and R. Flagg (Texas Engineering Experiment Station Bulletin 34 (1927), pp. 28, pls. 10).—The results of an investigation of the characteristics of anti-knock fuels and of materials to be added to ordinary fuels for use in internal combustion engines are reported in considerable detail.

Tests were made on two different solutions of nitro-aromatic hydrocarbons, a solution of tetraethyl lead, two gasolines containing large quantities of cracked hydrocarbons, materials containing large quantities of nitrobenzine and materials consisting largely of nitrated hydrocarbons. The results indicated that the anti-knock fuels and so-called doped fuels improved the operating characteristics of the engines, did not cause the power to fall off abnormally at high speeds and did not cause high temperatures in the exhaust system. The consumption per horsepower-hour was also not abnormally high at the higher speeds, there being little difference between the anti-knock fuels and ordinary fuels in this respect. In the case of one of the nitrated hydrocarbons both the power and the economy were improved.

It was found that while the use of such fuels will permit changes in engine design resulting in increased economy, there is little or nothing gained aside from the smoother performance of the engine when the price of these materials is considered. The use of these dopes and special fuels very materially increased the smoothness of engine operation at low speeds and under heavy loads. They also yielded satisfactory operation with the carburetor adjusted for a leaner mixture than with the ordinary gasolines.

Comparison of Methods of Measuring Knock Characteristics of Fuels, C. Edgar (S.A.E. [Society of Automotive Engineers] Journal, 22 (1928), No. 1, pp. 41-48, figs. 4).—It is reported that nine laboratories, employing widely different methods, cooperated in the measurement of the knock characteristics of five selected motor fuels. Considerable divergences are reported in the results obtained by different methods, especially for certain fuels, although there is reasonable agreement for other fuels. Laboratories using the bouncing pin method showed consistent results among themselves. The experimental results are tabulated and are also presented graphically.

From the data presented it appears that considerable divergence is to be expected from the results of different methods of testing fuels even on the specific problem of measuring the quantity of tetraethyl lead needed to equate them. It is also evident that the various scales for rating fuels used at present can not be interpreted readily among different laboratories. It is suggested that rating fuels in terms of two pure hydrocarbons, preferably as nearly alike as possible in their physical properties, should go far in solving this problem. Mixtures of normal heptane and 2.2.4 trimethyl pentane seem ideally suited for this purpose.

So far as the present tests go the bouncing pin method of deterpining the equality of knock of two fuels seems to be reasonably satisfactory.

Shape of the Water Table in Tile Drained Land, W. W. Weir (Hilgardia [California Station], 3 (1928), No. 5, pp. 143-152, figs. 5).—Studies are reported which showed that, under widely different soil conditions and widely different spacing and depth of tile, the water table between lines of tile is practically a straight line except within a very short distance of the tile. The depth of tile or the spacing between lines of tile does not materially alter the shape of the water table. The water table under certain conditions may stand above a tile line at points directly over it and yet the drainage be efficient and the tile lines only partially filled with flowing water.

Because of the flatness of the water table, it is considered probable that the major part of the lateral adjustment in the water table due to the removal of water by a drain takes place below the flow line, and in that portion of the water table above the flow line the movement is largely vertical. The depth of the tile rather than the spacing between tile lines is therefore considered to be the more important feature affecting the efficiency

of a drainage system. Thus, to obtain the same efficiency in areas where the vertical pressures differ, the tile must be either deeper or closer together in the case of the greater pressure.

Motor-Oil Characteristics and Performance at Low Temperatures, R. E. Wilkin, P. T. Oak and D. P. Barnard, 4th (S.A.E. [Society of Automotive Engineers] Journal, 22 (1928), No. 2, pp. 213-220, figs. 12).—The results of an experimental study of the viscosity characteristics of motor oils at low temperatures and their influence upon cranking torque and circulation within the engine are reported. It was found that at temperatures in the neighborhood of 0 deg. F. even oils of asphaltic origin appeared to possess some plastic characteristics, while those of the mixed and paraffin-base types deviated widely from the generally accepted laws of viscous flow. Oils of the latter classes have apparent viscosities which tend to increase with decreasing shearing-stress and to become somewhat greater than might be expected from a study of their characteristics at normal temperatures. It was found, however, that the relatively small temperature-viscosity coefficient of the wax-bearing oils gives them a marked advantage over those of asphaltic origin in cranking, an advantage which becomes greater as the temperature is lowered.

Circulation tests in an engine equipped with a comparatively small mesh screen over the pump intake indicated that circulation was not obtained until the oil in the sump attained its pour-point temperature. The results in general indicate that a low temperature-viscosity coefficient is highly desirable to minimize cranking effort and that free circulation requires an oil, the effective viscosity of which does not increase too rapidly at very low shearing stresses.

The Movement of Water in Soil and the Action of Drainage [trans. title], O. Solnar ([Czechoslovakia] Ministerstva Zemedelstvi, Sbornik Vyzkumnych Ustavu Zemedelskych) No. 25 (1927), pp. 89, figs. [19]; Ger. Abs., pp. 70-79; Fr. abs. pp. 80-88.—Studies are reported which indicate that rain water penetrates the soil only when the soil is cultivated, and that the differences of temperatures between the soil and the air are of the greatest importance in soil moisture movement. Vertical movement occurs only when sufficient heat is present to furnish the necessary energy, this being limited by the depth at which daily variations in temperature have an effect. Such depths therefore indicate the logical depth of drainage, which has been found to be about one meter, under the soil and climatic conditions tested. It was found useless to place drains at a greater depth than that which limits the effect of daily variations in temperature.

It was further found that a determination of the spacing of drains on the basis of depth is not correct. Apparently the moisture in soils is regulated by the diffusion of gases, the greater the pore space in soil the more intensive being the diffusion. The water content of pores hinders the diffusion of gases. This is particularly important in clay soils in which the greater part of the pore capillary space is filled with water on account of the greater water capacity. For this reason the drain spacing must be small in clay soils in order to permit the influence of diffusion to reach a maximum. Lighter soils containing a greater number of noncapillary pore spaces which are not filled with water permit a more extensive diffusion of gases. The action of drainage is therefore more intensive, and a greater spacing of drains can be used.

Principles Governing the Choice, Operation and Care of Small Irrigation Pumping Plants, C. N. Johnston (California Station Circular 312 (1928), pp. 28, figs. 11).—It is pointed out in this publication that the four outstanding types of pumps now in use in California irrigation are the centrifugal, the deep well turbine, the screw and the plunger. Air lift and rotary displacement pumps are found occasionally but serve only small irrigated areas. Centrifugal pumps are best fitted to operate in case of surface waters or shallow underground supplies. Deep well turbine pumps are similar to the centrifugals in performance but may be used to pump water from almost any depth.

Screw pumps may be used for both long and short lifts and are characterized by their large capacity. The air-lift pump has as its chief asset its simplicity and lack of wearing parts. Its application to irrigation is limited to special conditions because of its low efficiency. Plunger pumps are generally used in irrigating comparatively small tracts because of their limited capacity. Their use is also limited by the fact that abrasive materials in the water supply destroy their efficiency. The rotary displacement pump has the same limitations as the plunger pump, and can be used only for surface or shallow underground waters.

The results of the study are taken to indicate that pumping plant efficiencies should not be below fifty per cent.

Carbon and Nitrogen Transformation in Fresh Sewage Solids Digestion, H. Heukelekian and W. Rudolfs (Industrial and Engineering Chemistry, 20 (1928), No. 2, pp. 177-179, figs. 2).—In a contribution from the New Jersey Experiment Station experiments on the carbon and nitrogen changes in the digestion of limed and unlimed fresh solids are reported. It was found that there is no reduction in the total nitrogen content in a given volume of digesting sludge. The percentage of nitrogen of the volatile matter, on the other hand, increases as a result of the reduction in the volatile matter. The increase of carbon content of the volatile matter and the reduction of volatile matter in the unlimed material just balance each other. There is a greater reduction of volatile matter and carbon in the limed material. The most rapid rate of carbon reduction takes place after the cellulose decomposition stage, and it is suggested that cellulose decomposition products, as well as the decomposition of fats, cause this rapid reduction of carbon. It is pointed out that a greater proportion of the organic matter decomposed is gasified as a result of liming.

Data on Machinability and Wear of Cast Iron, T. H. Wickenden (S.A.E. [Society of Automotive Engineers, New York, N. Y.] Journal, 22 (1928), No. 2, pp. 206-212, figs. 10).—The results of studies are reported which indicate that the hardness or chemical composition of an iron is, by itself, no indication of the wearing properties and machinability of the iron. Irons containing a large amount of free ferrite were found to wear rapidly, whereas others having considerable pearlite or sorbite in their structure showed good wearing properties. The presence in cylinder blocks of excess carbide spots or of phosphides of high phosphorus content is deleterious because such spots wear in relief and the material ultimately breaks out, acting as an abrasive that scores the surface of the piston and cylinder walls.

The addition of nickel or nickel and chromium to the iron is suggested as a means of obtaining the correct microstructure for a combination of good wearing properties and machinablity. Since greater hardness is the result of a harder matrix rather than of an increase in the number of carbide spots, it has been found to be a good index of the improved resistance to wear, and to overcome the difficulty due to the hammering of the valves into their seats.

Analyses of cylinder blocks, pistons and other engine parts in which nickel and chromium have been used are given, and the improvements secured in the performance of these parts are described.

Desiccation of Sugar Beet and the Extraction of Sugar, B. J. Owen (London: Ministry Agriculture and Fisheries, 1927, pp. 84, pls. 23, figs. 19).—Studies are reported which showed that the desiccation of sugar beet is analogous to the desiccation of other crops, with modifications resulting from the nature of the raw material, and the object of drying which has the preservation of one constituent as its sole aim. It has been found that dehydration of organic vegetable substances or products in masses of relatively small thicknesses can be successfully obtained by means of an appropriately balanced process, which is based upon certain specific factors primarily dependent upon the composition and properties of the beet. These factors are, consolidation, volume of air, pressure of air, time of treatment, thickness of material and temperature of the air at varying moisture ranges.

The data show that influences occur analogous to those which have been ascertained and determined by experiment in the drying of other crops. The laws governing the process show that sugar beet in a moist state should, in order to avoid caramelization and inversion, not be heated to a temperature exceeding 220 deg. F. The drying operation must be accelerated as much as possible without raising the temperature of the beet above the critical temperature. Satisfactory results were obtained by extending the treatment over a period of time not exceeding one hour. It was also found that such quantity or weight of beet cossettes as is usually subjected to treatment can be economically dried in the course of 45 min. As regards porosity or penetrability, the natural resistance offered by the cossettes to the passage of the heated air is materially affected during the course of the drying operation by shrinkage, which amounts to about 50 per cent, while the resistance during drying decreases gradually with the reduction of moisture content to approximately 25 per cent of the original resistance. The porosity or penetrability of the material can be further increased, with a corresponding reduction in the time of treatment, by slicing or cutting the beets into thin ridge-tile shaped cossettes, the surface of the material exposed to the air per unit weight being thus increased to the greatest possible extent.

When the beet is dried at rest, whether in the form of a column or bed, and air is passed continuously through the depth or thickness of the entire mass, drying has been found to be effected to the best advantage and with the greatest economy by passing the air at a supply temperature ranging from 180 to 212 deg. F. through a depth or thickness of material of from 8 to 12 in. It is thus possible to discharge the air from the material in a state of saturation at an exit temperature of from 80 to 90 deg. F. during a period of time ranging from one-half to two-thirds of the total duration of the process. The material can be dried in not much more than one hour to a moisture content of from 5 to 10 per cent. These conditions can be obtained by employing a volume of air, saturated at a temperature before heating, of from 50 to 60 deg. F. at the rate of from 1,200 to 1,400 lb. of air per min. per ton of beet with a velocity of air of from 230 to 280 ft. per min. at an initial pressure ranging from 1.5 to 2.5 in. Owing to the shrinkage of the material and to changes in porosity during drying the initial pressure can be gradually reduced to from 0.4 to 0.7 in.

When the beet is treated in continuous or intermittent motion and the air is passed at intervals through it so that the material is progressively dried, the respective supply temperatures of the air for each passage through the material should not much exceed 212 deg. F. for the first passage, 230 deg. F. for the intermediate passage, and 260 deg. F. for the last passage. Where the respective supply temperatures of the air are graduated for each passage according to the progressive decrease of moisture content, the most satisfactory results have been obtained by using supply temperatures which are graduated from 190 to 220 deg. F. for the first passage, from 220 to 250 deg. F. for the intermediate passage, and from 250 to 320 deg. F. for the last passage. Whether the temperature be constant or graduated, the drying is effected by massing or piling the fresh material to a depth or thickness ranging from 5 to 9 in., it thus being possible to discharge the air from the fresh material in a state of constant saturation at an exit temperature of from 110 to 120 deg. F. and to remove from 50 to 60 per cent of the total moisture present in from 15 to 20 min.

Digestion of Vegetable Wastes and Screenings in Sewage Treatment Plants, W. Rudolfs and H. Heukelekian (Water Works, 67 (1928), No. 3, pp. 113-116, figs. 3).—Studies conducted at the New Jersey Experiment Station are reported, the results of which indicate that the digestion of vegetable waste in possible in treatment plants receiving domestic sewage. However, it requires an increase in digestion capacity equivalent to the increase in weight of the solids to be handled and also a greater digestion capacity on account of the slower rate of digestion. Anaerobic digestion of vegetable wastes, and possibly of garbage, is possible, but requires a longer time. The low content of nitrogen results in a poor nitrogen-carbon relation which affects the proper growth of the organisms responsible for decomposition. It does not appear that separate digestion of mixed carbonaceous vegetable matter is economical.

The Losses to Agriculture Caused by the Spontaneous Combustion of Haystacks [trans. title], G Laupper (Mater. Etude. Calamites, 3 (1926), No. 10, pp. 112-140, pls. 4, figs. 3; Fr. abs. pp. 136-138; Eng. abs., pp. 138-140).—It is pointed out that the losses from this occurrence in Switzerland are considerably greater than is generally supposed. It has been found that when hay is being stacked the individual straws become thoroughly mixed and form regular, compact layers. The stack is thus made up of a series of strata which is a necessary condition for the formation of combustion chambers inside the stack. Even when apparently dry, hay always contains a certain amount of moisture, and after being thoroughly exposed to the sun its initial temperature is fairly high. The living vegetable cells develop heat and moisture, thus creating favorable conditions for bacterial development. The heat thus generated accumulates in the stack and the moisture condenses in the upper strata, making them soft and disintegrating the cellular matter. The soluble carbohydrates combine with the albumens and vapor into a sticky cement which amalgamates the hay stratum into a nonconducting mass. Below this mass a combustion chamber is formed in which dry distillation takes place, producing water vapor and carbon dioxide. The heat of the combustion chamber increases steadily as does also the pressure of the gases. The latter are liable to escape violently either through a newly formed chimney or as the result of the explosion of the haystack. The products of distillation mixed with air produce a kind of detonating gas which is the immediate cause of spontaneous combustion. The latter is due to the action of pyrophoric iron.

In one experiment hay was calcined in an air-tight receptacle at from 250 to 300 deg. C. (392 to 572 deg. F.). The charred mass was then poured out hot on to a plate and became incandescent after a few minutes. This phenomenon was found to be due to the presence of pyrophoric iron produced by cellulose. Charred hay from which all iron was extracted did not react in this manner. However, the same result could be secured by restoring the removed iron in the shape of protoxide of iron or in solution.

The fact that hay which has been thoroughly exposed to the sun's rays must be richer in hydrocarbons is advanced as the reason why more stacks are destroyed by fire during a good hay season. Annual statistics of haystack fires are presented to support this hypothesis, showing that the smallest number of fires have occurred in the wettest years. The monthly data show a maximum in July and August, and high figures also in October and November on the one hand and in January, February, and March on the other.

Studies of means of prevention lead to the conclusion that there is no sure cure. Ventilation proved worse than the trouble. Layers of straw or of salt were also equally useless. The only measure which is recommended is to spread the hay on the ground as soon as abnormal temperatures are noticed.

An apparatus is described for use in detecting threatened combustion.

Wind-Pressure Tests Made on Large Model building, E. R. Dawley (Engineering News-Record, 100 (1928), No. 13, pp. 508-510, figs. 4).—Studies conducted at the Kansas State Agricultural College are reported in which a series of wind tunnel tests on a large model building were conducted. Tests were made as follows, placing the building in both crosswise and endwise positions in the wind tunnel: (a) framework only, (b) building covered and with doors and windows closed and (c) building covered but with doors and windows removed.

The wind pressure was found to vary with a power of the velocity slightly higher than the square. The exact formula for the maximum pressure from this experiment is $P = 0.00176V^{2.05}$ at 125 mi. per hr. Many of the other formulas, such as that of Rankine and Smeaton, were found to be two or more times too high.

Window shutters that can be securely fastened are recommended for localities subject to hurricanes or even tornadoes. For other light buildings, which are sometimes carried bodily away, anchor bolts are recommended for both the roof and the walls. It was also found that building frameworks in the preliminary stages of construction may be subjected to wind stresses at a given wind velocity in excess of those possible after the building is completed. Hence greater care is recommended in providing wind bracing during construction. It is suggested that structures may be designed to withstand lateral pressure of 35 lbs. per sq. ft. without undue expense.

The Combined Harvester-Thresher in the Great Plains, L. A. Reynoldson, R. S. Kifer, J. H. Martin, and W. R. Humphries (U. S. Department of Agriculture (Washington, D. C.) Technical Bulletin 70 (1928), pp. 61, figs. 18).—Data on the use of the combine in the Great Plains region are presented, indicating that this machine has given general satisfaction for wheat harvesting in the region. Combines most generally used in the Great Plains region have cuts of 12, 15 or 16 ft., and each is equipped with an auxiliary engine and is drawn by a tractor. The number of acres cut per hour were found to range from 1.6 for the 8-ft. machines to 4.5 for the 20-ft. machines. On the average 0.6 gal. of gasoline per acre was used in the auxiliary engine. A tractor with a drawbar rating of 15 hp. was most generally required on combines with auxiliary engines. The fuel used in the tractors on combines equipped with auxiliary engines averaged 0.8 gal. per acre.

For all combines depreciation averaged 44 cents per acre. There was no apparent relation between the acres cut annually and the estimated life of the machine.

For small acreages the expense of harvesting with a combine was found to be greater than with either a binder or a header. Where sixty or more acres are to be harvested with a binder, or 100 or more with a header, the small combine may prove more economical than these machines. Where three hundred or more acres are to be cut, the fixed charges of the combine per acre are reduced, and the machine is then operated at the lowest cost.

The average harvesting loss with combines was found to be 2.6 per cent of the total yield as compared with 3.3 per cent for a header and 6.1 per cent for a binder. The average threshing loss with combines was 1.9 per cent of the grain threshed as compared with 1.2 per cent for the stationary thresher.

It was found that beet during drying is subject to chemical and physical changes of a delicate character. For practical drying within such limits, it would appear necessary therefore to use a system of drying in the mass which will afford not only a precise mechanical control but also utilize the physiological processes which occur in the drying and so protect the sucrose in the beet.

Sections are included on extraction, sugar production, and purification, together with appendixes on cell rupture, the effect of drying upon the nitrogenous substances in sugar beets, treatment of effluents, and control measures. No confirmation could be obtained of a hypothesis that a two-stage drying process is necessary for the drying of beet.

A Study of Fundamental Factors Influencing the Traction of Wheel Tractors, J. W. Randolph and M. L. Nichols (Alabama Station (Auburn, Ala.) Report 1925, pp. 12, 13).—It is reported that the greatest factor in the transmission of force from any lug depends upon the tractor taking the fullest advantage of the arch action of the soil. The resistance to shear determines the tractive value of a soil. If the soil is confined by a rim the shear area is increased by bringing the line of shear more nearly parallel to the surface of the ground, the shear angle of unconfined soil being 45 deg. With a given width of rim, the output increases up to a maximum as the weight carried by the wheel is increased up to a certain point. With a further increase in weight the output decreases. The highest efficiency is produced with a weight on the wheel just sufficient to force the lug into the soil, and the output increases with the width of the rim under these circumstances.

Formulating a Definite Program of Farm Electrification, J. C. Scott (Electrical West, 60 (1928), No. 3, pp. 131-134, figs. 7).—A brief statement is given of the points to be considered in the development of a farm electric load.

Experience With Electric Stoves, O. E. Robey (Michigan Station Lansing, Mich. Quarterly Bulletin 10 (1928), No. 3, pp. 110-112, fig. 1).—Data on the operation of three electric stoves are briefly presented.

Highway Bridge Surveys, C. B. McCullough (U. S. Department of Agriculture, Washington, D. C., Technical Bulletin 55 (1928), pp. 76, pl. 1, figs. 45).—This bulletin discusses the features to be included in a detailed bridge survey.

Laboratory Tests on Physical Properties of Water-Bearing Materials, N. D. Stearns (U. S. Geological Survey, Washington, D. C., Water-supply Paper 596-F (1927), pp. IV + 121-176, pls. 3, figs. 9). —The apparatus and technique for such tests are described and illustrated, and typical results from experiments are tabulated and discussed.

Bearing Capacity of Soil, C. Terzaghi (Engineering News-Record, 100 (1928), No. 16, pp. 629, 630).—In a contribution from the Massachusetts Institute of Technology a restatement is given of the basis for rules as to bearing capacity of cohesionless and cohesive materials.

Book Review

"Muscles or Motors?" is a booklet recently published by the International Harvester Company. It points out the greater economy and many other advantages of mechanical power as compared with man and animal power. Illustrations show various applications of mechancal power to farm operations. Several pages are devoted to the duty of common types of power driven farm machines. Copies of the booklet may be obtained from the International Harvester Company.

Bibliography on Electric Range Cooking. A bibliography of articles on the history, cost, care and operation of the electric range has been prepared by Alice M. Child and Florence Connolly Kelley, Division of Home Economics, University of Minnesota. Articles dealing with methods of cooking and care of small equipment for cooking have not been included. The books, bulletins and periodicals listed date from 1914 to 1927, most of them having been published since 1917. Copies of the bibliography may be secured from the National Electric Light Association, 420 Lexington Ave., New York, N. Y.

AGRICULTURAL ENGINEERING

Established 1920

A journal devoted to the advancement of the theory and practice of engineering as applied to agriculture and of the allied arts and sciences. Published monthly by the American Society of Agricultural Engineers, under the direction of the Publications Committee.

PUBLICATIONS COMMITTEE
J. B. Davidson, Chairman
G. W. Iverson P. S. Rose
F. A. Wirt R. W. Trullinger

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Contributions of interest and value, especially on new developments in the field of agricultural engineering, are invited for publication in this journal. Its columns are open for discussions on all phases of agricultural engineering. Communications on subjects of timely interest to agricultural engineers, or comments on the contents of this journal or the activities of the Society, are also welcome.

Original articles, papers, discussions, and reports may be reprinted from this publication, provided proper credit is given.

RAYMOND OLNEY, Editor

"A Most Vital Factor"

"I LOOK upon agricultural engineering as the most vital factor in our vitally important agricultural industry. Without the research and achievements which have been developed in this field, our agriculture today would be in much the same condition as it was a century ago."

The foregoing paragraph is a quotation from the address by William Butterworth at the annual banquet of the American Society of Agricultural Engineers held in Washington in June. William Butterworth, in addition to his position—well known to agricultural engineers—as president of Deere & Company, was recently elected president of the Chamber of Commerce of the United States.

The quotation from his address is not only a tribute to what has been accomplished in the field of agricultural engineering, but it is also an appreciation of the place and possibilities of engineering in the future development of agriculture.

Mr. Butterworth, like other leading American business men, realizes that what has been done in the application of labor-saving machinery and methods, combined with sound management and adequate financing, to develop the manufacturing and transportation industries of the country far beyond that accomplished anywhere else in the world, can also be applied to the industry of agriculture with essentially the same results. This idea is not only being rapidly accepted by American farmers and other groups of business men closely allied with the agricultural situation, but its actual application is going ahead on an extensive scale, more so perhaps than is generally appreciated.

This development is a real challenge to the agricultural engineering profession. It is very much of a challenge to those members of the profession who are charged with the very responsible and very important task of training the agricultural engineers of tomorrow. As agriculture is at the same time the most fundamental and the most complex industry, it calls for engineers with training the equal of that of any group of engineers and scientists. It may be said that most of those who are responsible for the work of training agricultural engineers are very much alive to this need and are putting forth their best efforts to accomplish the desired results.

Agricultural engineering is indeed a most vital factor in agriculture, and agricultural engineers are meeting the many problems that confront them in a highly intelligent and courageous manner.

Chemist and Engineer

DISCUSSING the utilization of cornstalks and other agricultural by-products before the American Chemical Society Institute in session at Evanston, Illinois, at this writing, Dr. G. M. Rommell, of the U. S. Department of Agriculture, cautioned that the efficient handling of waste materials is essential to their profitable use. He pointed out that inasmuch as cornstalks, and other waste materials, are cheap products, the handling charge is apt to be too great to justify the utilization of such products unless kept at the lowest possible minimum by the use of machinery. Of particular significance to agricultural engineers is Dr. Rommell's statement that "if we are to find value in cornstalks we shall have to extend engineering and skilled management to the farm. Perhaps the biggest thing to come out of the use of corn waste will be to develop better engineering conditions in the corn belt."

Chemists and engineers have a great deal in common in the development of the new agriculture. The chemists are finding a multitude of profitable uses for agricultural by-products. It is the function of the engineer to develop the most efficient machinery and methods for the utilization of these products to the greatest profit of the agricultural industry. Millions of tons of material now go to waste on American farms not only for lack of knowledge as to how it can be used most profitably, but also for lack of machinery and equipment to convert this waste into profitable by-products.

Agriculture offers a tremendous field for both the chemist and the engineer, and with the proper coordination of effort between chemist, engineer, and farmer, tremendous developments and benefits therefrom will result.

A Good Showing

THE list of past-presidents of the American Society of Agricultural Engineers now numbers twenty-two. Only two of this number are not now living, and only three are no longer active members of the Society.

At the annual banquet held during the recent annual meeting of the Society at Washington, the past-presidents present were asked to stand on their feet. Eleven of them, or exactly fifty per cent, responded.

This is indeed a good showing. The Society has been most fortunate in the selection of its presidents. Their elections have been on the basis principally of their past service to the Society. It is interesting to note that they have continued to render the Society the fullest possible measure of service within their power, even after participating in the glory of the highest honor it is possible for the Society to pay one of its members.

The Society appreciates its past-presidents.

Who's Who This Month

THIS month we present on the "Who's Who in Agricultural Engineering" page four charter members of the American Society of Agricultural Engineers, who always have been and still are very active in agricultural engineering work. Of the handful of charter members who organized the Society at the University of Wisconsin in 1907, there are still nine of the original members, or nearly fifty per cent, who still hold active membership in the Society.

Our charter members have been a particularly loyal group. They have worked hard to see the fruition of their wisdom and foresight of more than twenty years ago. In view of the progress the Society has made, and the unusual development in the agricultural engineering field which now seems imminent, these pioneers may well feel that their early judgment was sound and their loyalty to agricultural engineering anything but a devotion to a lost cause.

It is a distinct honor to be accounted a charter member of an organization that has had a successful and creditable existence and which renders a real service to its particular field.

Who's Who in Agricultural Engineering


J. B. Davidson


E. A. White


L. W. Chase


C. I. Gunness

J. B. Davidson

J. Brownlee Davidson (Charter A.S.A.E.)—new chairman of the College Division of the American Society of Agricultural Engineers—is professor of agricultural engineering and head of the department at Iowa State College. He was the first president of the Society, and is often referred to as the "dean of agricultural engineers." He is a graduate in both mechanical and agricultural engineering from the University of Nebraska. He established the department of agricultural engineering at Iowa State College in 1905, the first of its kind and the first to offer a degree course in agricultural engineering. He has held his present position since that time, except for four years (1915-19) when he was chief of the agricultural engineering division at the University of California. During 1926 he served as director of the U.S.D.A. Survey of Research in Mechanical Farm Equipment. He has held many important positions in A.S.A.E. He has represented the Society on the Committee on the Relation of Electricity to Agriculture since it was organized in 1923. He was the secretary of the Society when its monthly journal, AGRICULTURAL ENGINEERING, was started in 1920. He is editor of the Wiley agricultural engineering series of books and author of a large number of books, bulletins and papers on agricultural engineering.

E. A. White

Doctor White (Charter A.S.A.E.)—past-president of the American Society of Agricultural Engineers—is director of the Committee on the Relation of Electricity to Agriculture. Following graduation at the University of Illinois he became head of the farm mechanics department at that institution, which position he held for several years. He was later associated with the Holt Manufacturing Company, "Farm Implement News," and the Class Journal Company. When the C.R.E.A. was organized in September, 1923, he was chosen as its director. The part he has played in establishing the agricultural engineer and the service he can render in the electric light and power industry, in connection with rural electrification, is not only a great personal achievement, but it is also an outstanding contribution to the advancement of the agricultural engineering profession. Throughout his professional career he has devoted a great deal of effort to stimulating interest in research work in agricultural engineering. He was the first to receive a Ph.D in agricultural engineering, which was granted to him by Cornell University. He has been an active participant in A.S.A.E. affairs; in addition to holding a number of important committee appointments, he was the fourteenth president of the Society, serving in 1921, and chairman of the Rural Electric Division in 1927-28.

L. W. Chase

L. W. Chase (Charter A.S.A.E.)—past-president of the American Society of Agricultural Engineers—is president and general manager of the Chase Plow Company, Lincoln, Nebraska. He is a graduate in mechanical engineering of the University of Nebraska; he also holds a degree in agricultural engineering from Iowa State College. Soon after graduation he organized the department of agricultural engineering at the University of Nebraska. He held the position of professor and head of the department for many years; for a time before leaving the University he was chairman of both the agricultural engineering and mechanical engineering departments. He resigned several years ago to devote his energies to building up the company of which he is now president and general manager. During the World War he held a position as a major in the ordnance department of the army; he now holds a commission as lieutenant colonel in Officers' Reserve Corps. He served the A.S.A.E. as its sixth president; he was also secretary of the Society at one time, and has held a number of important committee appointments. He is author of a number of books, bulletins, and articles on agricultural engineering. At present he is a vice-president of the National Association of Farm Equipment Manufacturers and a director of the Nebraska Manufacturers Association.

C. I. Gunness

C. I. Gunness (Charter A.S.A.E.) is professor of agricultural engineering and head of the department at Massachusetts Agricultural College. He was graduated from the North Dakota Agricultural College in 1907 in the mechanical engineering course. Upon graduation he was employed as an instructor in the mechanical engineering department of that institution under P. S. Rose (another charter member of A.S.A.E.). The principal courses in agricultural engineering instruction at that time were steam and gas tractor operation. He assisted in inaugurating one of the first intensive tractor short-courses in the form of a four-weeks summer school. He was appointed head of the department in 1909, on the resignation of Mr. Rose, and carried on the summer schools. He served as one of the judges of the Winnipeg Motor Competition in 1911. In 1912 he was appointed superintendent of the Indiana School of Tractioneering at LaPorte, an institution promoted by individuals in the M. Rumely Company. He went to the Massachusetts Agricultural College in 1914 to organize the department of agricultural engineering. He has served on a number of important A.S.A.E. committees and was chairman of the North Atlantic Section in 1927. He is at present one of the Society's representatives on the Advisory Council of the U.S.D.A. Survey of Research in Mechanical Farm Equipment.

A. S. A. E. and Related Activities

Interest at Land Clearing Session Centers on Explosives

A NUMBER of viewpoints on the cost, distribution and use of explosives in land clearing were represented in the land clearing session held in connection with the 22nd annual meeting of the American Society of Agricultural Engineers at Washington in June.

In a supplementary report on ditching with explosives A. J. McAdams, agricultural engineer, University of Missouri, stated that further investigations supported the type of loading for ditch blasting previously recommended. Mr. McAdams also demonstrated a model of a ditch blasting machine designed to use dry cells in place of the usual generator.

Land clearing work in the New England states was discussed by F. W. Knipe, agricultural engineer, Connecticut Agricultural College. He mentioned that they have had success with blowing the tops off of large stones and leaving the parts remaining below plow depth, rather than attempting to completely remove the stones.

H. B. Josephson, agricultural engineer, Pennsylvania State College, emphasized the importance of removing stones which interfere with and slow down field operations. He called attention to results of investigations by Pennsylvania State College which show the cost of rock removal to vary from $35 to $53, of which the cost of explosives was $4.50, and the other expense principally labor. As all of the rocks in this investigation had to be drilled, he believes there is a great need for a low-priced, portable air drill.

Cooperative or group buying of explosives was covered by N. A. Kessler, agricultural engineer, Northeastern Michigan Development Bureau; A. T. Holman, agricultural engineer, North Carolina State College; John Swenehart, agricultural engineer, University of Wisconsin, L. C. LeBron, agricultural engineer, Hercules Powder Company; and A. J. Schwantes, agricultural engineer, University of Minnesota. (Mr. Schwantes read a paper prepared by B. H. Gustafson of the same institution).

Since the distribution of surplus war explosives has been completed, one of the biggest problems in land clearing has been to supply the farmer with suitable explosives at a reasonably low cost. Cooperative buying of commercial explosives, to secure the advantage of carload prices and freight rates, has been tried with varying success.

The paper prepared by Mr. Gustafson outlined eight suggestions for cooperative buying, based upon experience in the distribution of pyrotol in Minnesota. The suggestions are as follows:

1. Cooperative buying should be a seasonal project (spring and fall) in order to get a large number of orders at one time.
2. The Farm Bureau, the representative of the farmers, should take the initiative wherever possible.
3. The price should be kept as low as conditions will permit.
4. Where present agencies are pooling orders satisfactorily, they should be helped and encouraged.
5. A deposit should be required on all orders.
6. Explosives should be sold on a cash-on-delivery basis only.
7. Two prices should be given on explosives, one at the car or truck delivery point and another from storage.
8. Caps and fuses should also be purchased in large quantities and the farmers given some benefit of the quantity discount.

Mr. Holman pointed out that the chief problems in land clearing are the removing of stumps and rocks from cultivated fields, the clearing of corners of odd and irregularly shaped fields, and the clearing of new land to make each farm an economic operating unit. This program, he pointed out, is prerequisite to successful utilization of modern farm machinery in lowering production costs and increasing production per worker. The clearing of additional areas of new or uncleared land should be discouraged he said.

The need of educational work in safe methods of transporting, storing and using explosives continues, according to Mr. Holman. In his own words, "This should begin with the local dealer, usually a hardwareman, who keeps dynamite, caps, kerosene, crowbars, monkey wrenches, coal and a red hot stove in the same compartment in the back end of the store."

Two methods of land clearing by means other than the use of explosives were discussed. G. R. Boyd, agricultural engineer, U. S. Department of Agriculture, talked on the use of poisons for killing trees and stumps. He described some of the experimental projects being conducted and mentioned that the indications so far are that some kinds of trees and brush are more susceptible to the action of poisons than others. The investigation has not progressed far enough as yet, however, to warrant publicity.

In the absence of W. A. Rowlands, agricultural engineer, University of Wisconsin, his report, entitled "Fire and Land Clearing" was read by Mr. Swenehart. The results of Mr. Rowland's work are contained in a circular published by the University of Wisconsin, entitled "Fire and Land Clearing."

A. S. A. Succeeds A. E. S. C.

RECONSTRUCTION of the American Engineering Standards Committee to keep pace with the growth of the industrial standardization movement in the United States is now under way. The principal features of the reconstruction are the definite federation of national organizations, under the name "American Standards Association," in such a way that trade associations interested in standardization may more readily join in the direction of the movement; placing the technical work of approving standards in a standards council; and concentrating administrative and financial responsibility in a board of directors composed of twelve industrial executives.

The reorganization has been unanimously approved by the main committee of the A.E.S.C., and is now being voted upon by the member-bodies. The action of the committee results from more than a year's intensive consideration of the subject by the main committee and rules committee.

Among the conditions which led to the reorganization are the growth of the trade association movement together with the predominating position which the trade association is coming to have in the field of industrial standardization; and the increasingly important direct part which the plant executive is playing in the standardization activities within his plant and in the movement as a whole. Recognition of this latter condition is reflected in the make-up of the board of directors, which will control the general administrative and financial affairs of the association. The industrial executives composing this board will be elected on nomination of member-bodies, and will serve for three years.

Approval of standards and matters of procedure will be in the hands of a standards council. The council will be composed of not more than three representatives of each of the member-bodies, the councillors also serving for a period of three years.

The underlying principles of the A.E.S.C. remain unchanged. The basic functions remain completely in the hands of the representatives of the member bodies. The individual members, whether of the board of directors or of the standards council, are appointed or nominated by the member-

bodies, which thus remain the fundamental units in the organization.

The name "American Standards Association" is being adopted as more accurately descriptive of the reorganized association, and also because of the misunderstandings and misconceptions which have frequently occurred in connection with the words "engineering" and "committee." The scope of the work is, however, being limited to those fields in which engineering methods apply.

The objects of the Association, as stated in the new constitution, will be: To provide systematic means by which organizations engaged in industrial standardization work may cooperate in establishing American Standards in those fields in which engineering methods apply, thus avoiding duplication of work and the promulgation of conflicting standards; to serve as a clearing house for information on standardization work in the United States and foreign countries; to further the industrial standardization movement as a means of advancing the national economy, and to promote a knowledge of, and the use of, approved American industrial and engineering standards, both in the United States and in foreign countries; and to act as the authoritative channel in international cooperation in standardization work, except in those fields adequately provided for by existing international organizations.

The revised procedure of the committee, which forms a part of the general reorganization, and in which there is much more flexibility than formerly, is already in effect. Under the new procedure, a sectional committee may operate autonomously, reporting directly to the A.E.S.C., or it may act under a sponsor as heretofore. "Proprietary" standards are recognized and may be revised within a single organization on condition that it be shown that the standard is acceptable to the groups concerned, a method particularly applicable to highly specialized fields. In very simple cases, approval is based upon the action of a conference followed by written acceptances of the interested groups.

Complete draft of the new constitution and by-laws will be sent on request to the Association at 29 West 39th St., New York, N. Y.

Rural Electric Papers Available

FIVE papers presented at the rural electric session of the 22nd annual meeting of the American Society of Agricultural Engineers held in Washington in June are available in printed form. These papers are as follows: "The Organization of an Electric Light and Power Company for Rural Development," by G. C. Neff, vice-president, Wisconsin Power & Light Co.; "Extension Methods for Rural Electrification," by H. B. Walker, professor of agricultural engineering, University of California; "Electrical Characteristics of Transmission Lines for Rural Service," by Frank D. Paine, supervisor, Iowa Project on Rural Electrification; "The General-Purpose Motor—Its Requirements and Possibilities," by C. P. Wagner, rural service engineer, Northern States Power Company; "Research in Rural Electrification, 1927," by R. W. Trullinger, agricultural engineer, Office of Experiment Stations, U. S. Department of Agriculture. Copies of these papers will be sent free on request to interested persons. Address Secretary, A.S.A.E., St. Joseph, Michigan.

Rural Electric Division to Hold Winter Meeting

DURING the rural electric session of the annual meeting of the American Society of Agricultural Engineers held in Washington in June, it was voted to ask the approval of the Council of the Society for a one or two-day meeting of the Rural Electric Division to be held in Chicago during the week of the International Livestock Exposition next December. The Council has approved the holding of this meeting and announcements regarding exact date and program will be issued later.

A two-day meeting of each of the Power and Machinery Division and the Structures Division of the Society will be held the same week. It is planned that the rural electric meeting will run parallel to the structures meeting.

December Meeting to Feature Large Farms

THE December meeting of the Power and Machinery Division of the American Society of Agricultural Engineers, to be held at the Hotel Sherman, Chicago, December 4 and 5, will be devoted entirely to the large farm. It is not the purpose of this meeting to sell the corporation system of farming, but it will be a real fact-producing meeting at which not only the mechanical but also the economic, social and nancial phases of corporation farming will be presented. Engi eers and managers of large farming enterprises will make up the majority of speakers at this meeting.

Irrigation of Rice by Deep Well Pumping

A TWO-YEAR project in a study of the problems involved in the irrigation of rice by deep well pumping has just established in Arkansas. The project is a cooperative one between the division of agricultural engineering of the U.S.D.A. Bureau of Public Roads and the Arkansas Experiment Station. S. H. McCrory, chief of the division, is leader for the U.S.D.A. and Deane G. Carter, agricultural engineer, is leader for the Arkansas station. B. S. Clayton is engineer in charge of the work which will be conducted on the rice branch experiment station at Stuttgart. (All three men are A.S.A.E. members.)

Case Buys Emerson-Brantingham

AN ANNOUNCEMENT of particular interest to the agricultural engineering field is that recently made by the J. I. Case Threshing Machine Company, Inc., Racine, Wisconsin, that it has purchased the implement plant and business of the Emerson-Brantingham Corporation, Rockford, Illinois. The purchase includes the implement plant at Rockford and the implement inventory at the factory and branches. The Case Company will take possession of its purchase on August 1 and will operate the factory from that date. It will retain the organization which is experienced in the manufacture and sale of E-B implements.

Personals of A.S.A.E. Members

Hobart Beresford recently resigned as agricultural engineer of the Idaho Power Company to accept an appointment as head of the department of agricultural engineering, University of Idaho.

E. Blodgett is now designing engineer for Freeman Manufacturing Company, Racine, Wis. He was formerly associated with the I. B. Rowell Company in a similar capacity.

Fred C. Fenton has been appointed professor of agricultural engineering and head of the department at Kansas State Agricultural College. He was previously associate professor of agricultural engineering at Iowa State College.

C. H. Jefferson recently became associated with the engineering department of the Clay Equipment Corporation, Cedar Falls, Iowa, where he will be engaged in farm building ventilation work. He was formerly assistant in agricultural engineering at the University of Wisconsin.

Geo. W. Kable, agricultural engineer, Oregon Agricultural Experiment Station, and project director of the Oregon Committee on the Relation of Electricity to Agriculture, is one of the authors of Bulletin No. 231 of the Oregon Agricultural Experiment Station, entitled "Electric Light for Increasing Egg Production."

M. R. Lewis recently resigned as head of the department of agricultural engineering, University of Idaho, to accept an appointment as drainage engineer in charge of cooperative irrigation and drainage investigations for the Oregon Agricultural Experiment Station and Division of Agricultural Engineering, of the U.S.D.A. Bureau of Pulic Roads. His first work in his new position will be an investigation of the irrigation and drainage possibilities of the Baker Valley in Baker County, Oregon, which covers a total of about one

hundred thousand acres and has a number of irrigation and drainage problems.

D. B. Lucas, assistant professor of agricultural engineering, Rutgers University, was granted a Ph. D. degree in the psychology of advertising in June of this year by the New York University. His thesis compared the relative values of the positive and negative appeal in advertising.

R. A. V. Nicholson, architect, Central Experimental Farm, Department of Agriculture of Canada, Ottawa, calls attention to two recent bulletins issued by the Dominion of Canada Department of Agriculture of particular interest to agricultural engineers: Bulletin No. 90 (new series) "Dehydration of Fruits and Vegetables in Canada," Bulletin No. 96 (new series) "The Conversion of Dry Roughage into a Succulent Feed (by the Sugar Jack Process)," and Pamphlet No. 79 (new series) "Producing Clean Milk."

J. Macgregor Smith, professor of agricultural engineering, University of Alberta, is author of Bulletin No. 17, entitled "Some Power Problems of the Farm," just issued by the Department of Extension of that institution.

New A.S.A.E. Members

Edward B. Archbald, farm manager, Archbald and Co., Waterport, N. Y.

C. W. Drake, general industrial engineer, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

O. E. Eggen, chief engineer, Hart-Parr Co., Charles City, Ia.

Bert S. Gittins, assistant, research department, National Association of Farm Equipment Manufacturers, Chicago, Ill.

Francis W. Holden, irrigation engineer, Hemstead, Long Island, N. Y.

Frank Irons, development agricultural engineer, European Corn Borer Control, U. S. Dept. of Agriculture, Toledo, Ohio.

David A. Isler, development agricultural engineer, European Corn Borer Control, U. S. Dept. of Agriculture, Toledo, Ohio.

Carlton W. Jones, consulting engineer, Towson, Md.

Arnold W. Perry, farmer, "Boorawa," Tarana, N.S.W., Australia.

Russell H. Reed, agricultural engineer, Dickinson, N. D.

John W. Savage, special promotion, General Electric Co., Bridgeport, Conn.

F. F. Wetmore, drainage engineer, Lumberton, N. C.

Lewis T. Wood, agricultural engineer, Virginia Electric and Power Co., Richmond, Va.

Transfer of Grade

R. H. Driftmier, associate professor of agricultural engineering, Kansas State Agricultural College, Manhattan, Kan. (Associate Member to Member)

Robert A. Norton, assistant drainage engineer, Division of Agricultural Engineering, Bureau of Public Roads, Washington, D. C. (Junior to Associate Member)

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the July issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Ernest L. Guttersen, general manager, North American Oil Co., Ltd., Winnipeg, Manitoba, Canada.

Maxie E. Landry, rural electrical power promotor, Wagner Electric Corporation, Kansas City, Mo.

David M. Morris, designer, International Harvester Co., Ltd., Hamilton, Ontario, Canada.

Employment Bulletin

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members as well as members, are privileged to use the "Positions Open" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER available. Seventeen years experience in the designing and manufacture of farm tractors, motor trucks, harvesting machines, and earth-working tools. Sales experience in United States, Canada, England, France, and Italy. Write for interview. MA-132.

DESIGNING AND RESEARCH ENGINEER with experience in developing equipment and machinery for commercial field. Several years experience in commercial research. Will undertake specific projects for business desiring the solution of problems in design, performance testing, or engineering analysis. MA-145.

EDITOR AND WRITER with ten years experience in farm mechanical equipment, from both trade journal and farm paper angles, specializing on promotion and technique of power farming. Qualified for publication, house organ, advertising literature, or sales promotion work involving technical accuracy and popular appeal. Farm background, college training, instructional experience. W. B. Jones, St. Joseph, Mich.

AGRICULTURAL ENGINEER desires position as general manager of large agricultural concern where initiative, ability and resourcefulness are required. Has knowledge of legal procedure and finance, has handled agricultural propositions employing three thousand men, speaks Spanish, recently carried out reorganization in Latin America for one of the largest banks in this country. Can furnish credentials as to character, integrity and sobriety. 40 years of age, excellent health, American native born, protestant, married. Will go anywhere but prefers continental U.S.A. MA-148.

MECHANICAL AND AGRICULTURAL ENGINEER, graduate of University of Michigan, with many years experience in the design, purchasing, production, manufacture, and sale of agricultural implements, iron pumps, hand and power spray machinery, and with a wide acquaintance with manufacturers, jobbers, and dealers, desires employment with a reliable and substantial manufacturer. Will go anywhere. MA-150.

Positions Open

AGRICULTURAL ENGINEER with college training and practical experience with tillage tools and seeding machinery wanted by a farm machinery manufacturer in the Middle West. Must be skilled draftsman and have designing ability. PO-132.

AGRICULTURAL ENGINEER capable of designing automatic shocking machine for commercial production from a factory model that has been successfully demonstrated in the field for four years wanted at once. Wire A. L. Marks, 407 Empire Block, Edmonton, Alberta, Canada, giving full particulars as to training, experience, references, and salary expected.

AGRICULTURAL ENGINEER wanted for position as teacher of farm machinery in a southern agricultural and mechanical college. Salary about $3000. Position has excellent opportunities. PO-135.

SERVICE MANAGER to organize field service, prepare instruction books, and repair parts list is wanted by power farming machinery manufacturer. Must be loyal, aggressive, and able to handle service men, dealers, and customers. Give full details of training, experience, references, etc., in first letter. PO-136.

MECHANICAL ENGINEER wanted by power harvesting machinery company in the middle west. Must be aggressive, loyal, ambitious, and capable of handling drafting room. Also must be able to cooperate with manufacturing department. State training and experience in first letter. PO-137.

AGRICULTURAL ENGINEER wanted by a steel products company to assist in the development of their line of sheet metal and steel articles for farm use. Must have good fundamental technical training and an understanding of agricultural practice, especially in the Northwest states. Duties will include some field work and investigation. The company has been established many years, is well rated and has excellent marketing connections. PO-138.

AGRICULTURAL ENGINEER wanted to do teaching and experiment station work in the agricultural engineering department of the Montana Agricultural Experiment Station and State College. The specific work will be in irrigation and drainage. Write H. E. Murdock, Bozeman, Montana.